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East Europe Report

SCIENCE AND TECHNOLOGY

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10 May 1985

EAST EUROPE REPORT

SCIENCE AND TECHNOLOGY

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INTERNATIONAL AFFAIRS

GDR-USSR COMPUTER TRADE, COOPERATION OUTLINED

Robotron Director Reports Achievements

East Berlin GDR EXPORT in English No 4, 1984 pp 2-3

[Article by Friedrich Wokurka, Director General, VEB Robotron Combine]

[Excerpts] In close co-operation with the USSR and the other socialist countries, a powerful computer, office machinery and measurement electronics industry has come into being in the course of thirty-five years of dynamic development of the GDR.

In this issue of GDR EXPORT, VEB Kombinat Robotron—an established exporting combine—presents its wide range of products and services. Industry, reliability, know-how, skill and expertise of over 70,000 workers, scientists, engineers and marketing specialists have, in the past years, increased our combine's performance to such an extent that today Robotron products can be found in over sixty countries. The stable growth of the GDR's economy has formed the background to this successful development.

Seventy per cent of the combine's output are exported. In line with the close economic, scientific and technical co-operation among the CMEA countries, most of the products being exported are geared to the economic requirements of these countries.

In the past ten years, exports to socialist countries have nearly quadrupled. Over sixty per cent of all exports

go to the Soviet Union. At the same time, imports from the CMEA countries have been growing continuously. Upwards of two hundred EC 1020 and EC 1022 electronic data processing installations from the GDR are in operation in the USSR. Robotron electronic data processing installations and small computers are equipped with peripheral units made in other socialist countries.

Multilateral co-operation covering the Unified Computer System (UCS) and the Small Computer System operated by the CMEA countries, and direct bilateral co-operation between manufacturing enterprises and scientific institutions of socialist countries, are essential prerequisites which enable the combine to meet its tasks. The Research Centre for Electronic Data Processing (NITSEVIT) in Moscow, the Institute for Electronic Control Computers (INEUM), and the international economic organisation Interatominstrument are among the institutions with which our combine has been maintaining fruitful relations for a number of years.

In preparing for the operation of Robotron electronic computer equipment in the USSR, VEB Kombinat Robotron has for several years been co-operating directly with the users in various branches of the economy. Such contacts, which are underpinned by contracts, agreements, and joint working plans, are in force with financial institutions, agricultural enterprises, and enterprises of the mineral oil industry. We have found that such working partnership is very useful for the Robotron combine, because in this way we can obtain ideas and conceptions directly from the users of our equipment and develop and produce our equipment accordingly. Over and above, this form of co-operation helps to elaborate user program packages.

Work on implementing the GDR-USSR intergovernmental agreement on scientific-technical co-operation, production specialisation and mutual deliveries of equip-

ment for the acquisition, recording and condensing of information, and the GDR-USSR intergovernmental agreements on communications, measuring and nuclear engineering, is likewise proceeding with great intensity.

Bilateral agreements on joint research and development projects, and on mutual goods deliveries and services are also in force with other socialist countries.

robotron Programme

The combine's production and export programme includes edp systems of the second UCS generation with complex application lines and comprehensive software, office computers, problem-oriented packages based on microcomputers, typewriters, word processors and drafting equipment, terminals and electronic measurement equipment.

System, standard and specialised software is developed and supplied in conjunction with the installation of robotron computers. This software is put at user's disposal in a special program and project engineering centre, in which more than 8,500 programs are currently stored.

ADP Installations Described

East Berlin GDR EXPORT in English No 4, 1984 pp 4-5

[Text]

Trade relations between the GDR and the USSR have developed successfully and there has been a steady increase in the goods exchange between the two countries. The EC 1055 and EC 1055 M edp installations which form part of the Second Generation of the Unified Computer System (UCS) account for a considerable share in this trade expansion.

The EC 1055 M, a modular-built system, has been designed for universal application. The advantages of socialist economic integration become particularly evident in the export of type 1055 edp installations covered by the 1968 UCS agreement. The majority of the peripheral equipment (made in Bulgaria, Poland, Hungary and the USSR itself) is supplied by the Soviet trading

partner directly to the customer. Assembly work is carried out by the Soviet NOTO organisation or jointly by specialists from the GDR, the USSR, Bulgaria, Poland and Hungary, as the case may be. On user's request, the compatibility of equipment other than type 1055 is examined and established by coupling tests.

Since 1974, 450 edp installations of types EC 1040, EC 1055 and EC 1055 M have been supplied to the USSR.

The EC 1055 M edp installation is backed up by efficient operating systems. The well-known OS/ES operating system comprises, *inter alia*, a control program configuration known as SVS (system of virtual storages) with the help of which an address space of 16Mbytes can be attained.

The SVM/ES system (system of virtual computing machines) is an extension of the SVS concept covering the entirety of the equipment included in the EC 1055 M edp system concerned. Within the framework of teleprocessing the EC 1055 M system is used as host computer.

Special Hardware Units of the EC 1055 M EDP System

The performance capability of the EC 1055 M system is further enhanced by linking a few special devices.

With the help of a channel adapter, for example, effective local multiprocessor systems can be formed. Being highly reliable, they are used to enlarge the edp system's processing capacity.

For solving certain problems associated with numerical mathematics, which require very large quantities of data to be handled within a reasonable time span, a special arithmetic unit known as matrix module (MAMO) is offered. This unit can be linked directly to an EC 2655 M central processor. Its use for data processing applications involving a large amount of mathematical operations affords the user a computing speed 50 times that of a computer which does not use this matrix module.

Close and Diversified Co-operation

VEB Kombinat Robotron co-operates closely with Soviet users in widely differing sectors of research and economy. Close ties backed by agreements, contracts and joint work schedules are being maintained with the following institutions:

- United Nuclear Research Institute, Dubna;
- Kurchatov Institute for the Peaceful Application of Atomic Energy, Moscow;
- Research Centre for Electronic Data Processing (NITSEVIT), Moscow;
- Ministry of the Petroleum Industry of the USSR;
- State Committee for the Supply of Materials and Equipment to the Agricultural Industry of the USSR;
- WAS and KAMAS auto works;
- GOSBANK and Foreign Trade Bank of the USSR.

Co-operation relations such as these benefit both the user and the producer. This way, effectiveness is increased and the range of program packages extended.

An outstanding example demonstrating the close and fruitful co-operation are the NEWA 1 M and ENSAD 4310 message exchange computers developed by Robotron along with specialists of the Institute for Cybernetics of the Academy of Sciences in Kiev, the Ministry of Posts and Telecommunications and the Central Research Institute of Communications in Moscow. This joint development forms part of the work aimed at evolving a unified system of electronic message switching. Meanwhile, VEB Kombinat Robotron has been commissioned by the USSR to commence serial production.

These control complexes can also be employed as a centralised control unit for different switching facilities. By doubling the control mechanism they ensure high reliability and flawless operation of the switching system even if one or several units of the control complex become inoperative. The breakdown rate of the switching system is claimed not to exceed two hours in twenty years.

This joint development is a key project implemented within the framework of socialist economic integration.

BULGARIA

DEPUTY MINISTER DWELLS ON COMPUTER TRAINING PROGRAMS

Sofia OTECHESTVO in Bulgarian No 5, 12 Mar 85 p 3

[Interview with First Deputy Minister of Machine Building Stoyan Markov by Georgi Markov of the magazine OTECHESTVO; date and place not specified: "Programs Paid for by the Job"]



[Text] [Question] Comrade Markov, do you not believe that an erroneous idea of personal computers has been created--that they are intended mainly for children and for the needs of education?

[Answer] Actually, we have channeled most of the microcomputers produced thus far into higher and secondary education in order to provide for the mass training of key personnel who will soon extensively enter the world of practice. The basic purpose of personal computers is indicated by the catalogues with programs for applications in agriculture,

in medicine, in architecture as measuring instruments, for outgoing quality control, for foreign language study, for the automation of engineer work, in administrative services. In volume, the clerical work of a people's council, a court, etc., for example, does not exceed the capabilities of the personal computer. Unfortunately, lack of computer know-how is still an obstacle to their speedy entry into the world of practice. And these are small, eight-bit computers with very modest capabilities. The new, 16-bit Izot-1036 and Pravets-82, which we must put into production this very year, are already more serious computers. Connected up with the network, they constitute a comparatively powerful computer system with diverse possibilities for application.

[Question] What objective prerequisites is your sector setting up for their introduction on a mass scale?

[Answer] This year we shall produce over 13,000 personal computers. Of these we shall again channel 6,000 into the needs of education (2,000 of them for

the Avant-Garde Engineering and Applications Economic Company). The object is that they should not only be used for training, but also to attract young people into programming and thus widen the possibilities for the introduction of computers into the national economy.

[Question] How will the wages of programmers be organized?

[Answer] In principle I would want to adopt the lump wage payment system-- announce how much the compilation of a single program will be worth and conclude a contract-order. Thus, individual program houses will be formed, i.e., groups of specialists producing programs either for personal, or for large, computers. There is ample work--they expect many orders from individual organizations, plants, agroindustrial complexes and institutes.

The assigner and organizer of this activity will be the Software Products and Systems Corporation and the Avant-Garde Company.

[Question] Who will determine the more urgent needs, and how?

[Answer] Two major discussions have been held with all the organizations that use personal computers and develop programs for them. The result is a kind of "stock-taking"--what has been procured and what we have created ourselves, what should be done in the future. In 1 or 2 years we must have 4,- or 5,000 programs for eight-bit, and at least 2,- or 3,000 programs for 16-bit, personal computers. The subjects treated will touch on all areas of life--from medicine to space.

[Question] In what sense is a technology in your area a basic technology?

[Answer] Houses, chemical plants, superhighways, metal-cutting machines, hybrid systems, integrated systems, etc., are planned on the same computers, with the same terminals and panels, with different software. In Sofia there are about 15 such teams. The different programs represent the accumulated experience of large groups, and their knowledge is used by everybody working with the program. The productivity of the labor of planners and designers is thus increased many fold; they are enabled to make practical use of the highest achievements in their particular field.

[Question] Comrade Markov, what would be the significance in practice of "making wide application" of computer technology in optimizing planning?

[Answer] A director and his subordinates must know how to write the plant plan as a mathematical model, while those who read it must be able to calculate the ratios and quality relationships that arise behind the figures. In this sense the economic know-how of managerial personnel is low for when they completed their education 15 to 20 years ago, this requirement was not part of their plan of studies at all.

The Bulgarian-Soviet Interprogram Institute, for example, has created a series of software products for the metallurgical industry and these are widely used in the Soviet Union. But the people who must implement a program and compile a mathematical model of a production process are in the plants themselves. It

is they who use programs and computers to lighten their own labor. It is not logical to expect others to make the models of their production process that they have to use every day in their work.

[Question] What kind of scientific program teams do you anticipate will be set up?

[Answer] The academies of sciences of the socialist countries with the participation of industry have decided to pool their efforts for the performance of fundamental and applied research on the new generation of computers. In Bulgaria, by decision of the government we have set up three laboratories which will work on high-efficiency systems of parallel calculations, on the computer network and on external stores based on new physical principles. A program team made up of the best specialists in a given area will be formed to solve every problem that arises. They will not leave the organizations where they are employed. These teams will also enlist specialists from the academies of sciences of the Soviet Union and other socialist countries.

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USE OF LASERS IN VARIOUS AREAS OUTLINED

Sofia ZEMEDELSO ZNAME in Bulgarian 19 Mar 85 p 3

[Article by Marko Markov: "On Lasers with . . . White Overalls and Tailor's Scissors"]

[Text] The "mysterious beam" of Bulgarian instruments is making its way into metallurgy, computer technology, construction, machine building, education. . .

Time was when lasers were talked about only in specialized physics publications. Only to come a period of rapid penetration of science and practice by the "mysterious beam," a time when lasers have sharply changed scientific research methods.

Bulgarian physics can now rightly pride itself on moving into the front ranks of research on lasers and their application for discovering the secrets of nature and matter.

Thanks to far-sighted scientific policy, laser physics today is an inseparable part of the technologies in many areas of the national economy. For several years specialists from the Bulgarian Academy of Sciences, the Optics Institute and the "Optikoelektron" Enterprise have been working on getting laser instruments into production. An applied scientific laboratory of laser technology has been in operation for years in the Physics Department of Kliment Okhridski Sofia University.

The reader will perhaps say, "All right, but what actually do these lasers do?" But it is more accurate now to ask: What don't lasers do? For laser systems can be discovered not only in metallurgy, but also in computer technology, in printing establishments, in doctors' offices. . . The laser has made its way also into construction, into machine building, into education.

Its application is widespread in geodesy and construction. The Institute of Geodesy and Cartography has developed a whole series of laser theodolites and levels. The LOS-2 laser level was used as early as the construction of the high-rise building of the Central Council of Trade Unions. Its fellow,

the LOS-1, is successfully "laboring" today on the building of the complex segment of the Khemus highway (around the Bebresh reservoir).

The LIR-1 instrument, one of the most significant achievements of the scientific-production laser-equipment laboratory at Kliment Okhridski Sofia University, is intended for cutting out holes. Its unique successor is the "Garant" [Guarantor], an instrument which has brought more than one prize to its creators. Among the objects for the practical application of these innovations is the colossus of our metallurgy--the L. I. Brezhnev Economic Combine at Kremikovtsi.

Our physicists have also made considerable progress in creating laser measuring systems. The Bulgarian Academy of Sciences has developed an entire series of interferometers which are used for spectral analyses, in photochemistry and in phototherapy--in other words, wherever the precise focusing of the laser beam's energy is needed. The LIU [lazernoto izmeritelno ustroystvo; laser measuring device]-1 (an achievement of specialists from the V. I. Lenin VMEI [Higher Machine-Electrical Institute], Sofia) is applicable in many areas of machine building.

When an exhibition of "Imaging Holography for Cultural Purposes" was opened 4 years ago in the lobby of Sofia University, many specialists were greatly surprised by the successes of Bulgarian physicists. For the magnificent holograms of exhibits from the world-famous Thracian gold treasure represented a new page not only in science, but also in museum work. But the scientists devoted to holography did not stop there. The technology of hologram making was continuously improved, and new hologram-recording materials were created.

The laser often "puts on" white overalls and crosses the threshold of doctors' offices. As early as 1976 the Medical Academy in Sofia opened the first laser laboratory for the treatment of eye diseases in the Balkan Peninsula. It has already had thousands of patients who gratefully recall the mysteriously flickering beam. Physics has helped medicine combat such diseases as glaucoma and detachment of the retina, myopia, etc.

The list of laser applications can be extended with hundreds of developments. Communications, power engineering, etc. are some of the targets. And the laser's prospects for the needs of controlled thermonuclear fusion are apparently most enticing. The Soviet "Del'fin" [Dolphin] system and the American ("Shiva") system are awaited with tremendous interest by power engineers. The use of the laser instead of tailor's scissors, as a microscope or navigator is no longer a daydream. The "mysterious beam" is increasingly making its way into our everyday life.

VASCULAR IMPLANTS MANUFACTURED IN BRNO

Bratislava PRAVDA in Slovak 9 Mar 85 p 3

[Article by Frantisek Zdobina: "Knitted Vascular Replacements"]

[Excerpt] The newspapers recently published a brief note about the conclusion of a 2-day consultation at the Knitting Industry Research Institute in Brno, at which experts from socialist countries decided to establish a CEMA Center for Research and Production of Special Textiles for Implants. Although this was obviously an important and interesting event, to the best of my knowledge our press published no more information about it.

From a letter by our reader Jan K. of Nove Mesto nad Vahom.

The institute is now celebrating its 35th anniversary; however, its R&D in the area of utilization of synthetic fibers in medicine did not begin until 1958, after the general theory of vascular replacements had been developed and its practical application promised certain benefit.

At that time our public knew very little, if anything at all, about research of this type and later about the application of its achievements; our readers will surely recall that attention was then focused on shirts and blouses made of silon. But that's the way the cookie crumbles; consumer goods attract more attention than inconspicuous R&D programs promising, as in this case, to restore health and often also to save many human lives.

It was not an easy task to develop and manufacture vascular replacements which may be used in vascular surgery. Prominent medical experts from all over our country, and above all researchers from the Institute for Clinical and Experimental Medicine in Prague, joined the efforts to resolve this problem. Artificial veins (experts will excuse the lay expression) must have most precisely specified properties: they must promote new formation of the natural vascular wall in the organism, their walls must be permeable, the thickness and elasticity of the wall are important. Furthermore, the surgeons called for more rapid assimilation in the site of the juncture of the artificial veins with the natural vessel. Surface treatment and fineness of individual fibers for artificial veins then play an important role in the nutrition of the newly developed vascular wall and in case of degenerative changes, while the longitudinal and transverse elasticity of the replacement must conform to the temperature and secure the accurate placement of the implant.

And now a few words of advertising: vascular implants are already being manufactured by the Knitting Industry Research Institute and are supplied in double-wrapped packages, sterilized by radiation, with a 3-year guarantee. It is self-evident that the implants must be handled with care.

The Knitting Industry Research Institute is an economic organization operating within the General Directorate of the Knitting Industry VHJ [economic production unit] in Prague. Naturally, it deals with some other tasks; for example, its experts designed technological equipment for the manufacture of knitted furs known by their brand name--Bonekam. The Sandra brand dry baby panties were developed here, and so on.

The institute supports itself with its earnings; its profits are sufficient, because on every 12th day it submits a registration of an invention or industrial specimen, and every 31st day the institute receives a certificate of authorship.

Public benefit from R&D of vascular implants and bandages made in Brno is estimated at Kcs 4.5 million annually.

Because the institute also owns a factory and employs several dozen highly qualified workers, we may describe its organizational arrangement and operation as research and production.

The Knitting Industry Research Institute in Brno has already established a tradition of very close contacts with several similar institutes in the USSR: This cooperation produced many inventions which benefit both countries.

Considerable credit for the decision of experts from socialist countries to establish the CEMA Center for Special Textile Implants R&D at the Knitting Industry Research Institute in Brno is due to Dr Eng Jan Dvorak. Unfortunately, that scientist, the director of the basic research department, did not live to see the fulfillment of his determined efforts. He had done so much for medical services, yet that did not help him when by an ironic twist of fate he was suddenly stricken with a stroke....

In April 1983 Dr Eng Dvorak took a business trip to the USSR. Upon his return he wrote a report for the administration of the institute, from which we quote: "During my negotiations in Moscow it was proposed to establish a joint CEMA institute. The Soviet partners recommended that such a facility be organized at the Knitting Industry Research Institute in Brno and that it specialize exclusively in textile implant materials.... In my opinion, the production of implant materials for all CEMA states should be centralized in that particular facility.... Thus, the CSSR will obtain a monopoly in the production of special goods made from synthetic fibers, which would be not only economically advantageous, but also feasible as regards raw materials. It will not depend on the whims of fashion and will greatly enhance human labor...."

The proposal made by Dr Eng Jan Dvorak was reasonable, advantageous--and it was adopted. He had no inkling that he had built himself a monument. His name is mentioned in most discussions concerning the construction of the center and the experts of the institute very often refer to his ideas and considerations.

Fundamental agreements concerning the establishment of the center have already been signed. It is envisaged that it will begin operating next year. Soviet experts and specialists are expected to be among the first to come for long-term professional assignments in Brno. The center will supply vascular implants and other medical textile materials for the needs in our country, the USSR and other socialist countries.

The building of the center involves a lot of work and problems; first of all, the institute must obtain the equipment and also secure housing for foreign scientists and researchers. Before one task is completed, other new tasks for research are assigned to the center, for example, the development of special surgical sutures in which perhaps every state is interested.

I doubt that more will be written and said in the future about the programs of the center than has been written and said thus far about the accomplishments of the Knitting Industry Research Institute in Brno, but that does not change the substance of the matter at all. The professionals and surgeons know the score and their appreciation carries much weight.

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10 May 1985

CZECHOSLOVAKIA

BRIEFS

CABLE TV TESTED--In the last few days workers of the Institute of Radio Technology and Electronics of the CSAV (URE) in Prague, in collaboration with workers of the communications industry, have conducted a series of experiments involving the transmission of signals along lighting cables over medium distances. A color television signal and a digital signal were transmitted along cables connecting two of Prague's telephone centrals. The attained speed corresponds to the simultaneous transmission of 120 to 480 digitalized telephone conversations. The signals were transmitted by a standard light cable along a wavelength of 0.85 micrometer over a distance from 5 to 15 km without the use of an intermediate relay station or booster. The terminal installation, containing the optical transmitter with a semiconductor laser diode and appropriate modulation, demodulation and synchronization circuits, was developed by the Institute of Radio Technology and Electronics of the CSAV. In transmitting the digital signal a maximum of one symbol per billion correctly transmitted signals was transmitted erroneously, which is an error rate fully appropriate for the transmission of data. In transmitting the TV signal a modulation making it possible to maximize the distance traveled with relatively simple terminal equipment was used. [Text] [Prague RUDE PRAVO in Czech 28 Mar 85 p 1] 5911

CSO: 2400/346

PROCESS CONTROL SYSTEMS FOR LARGEY AUTOMATED MANUFACTURING

East Berlin MESSEN STEUERN REGELN in German Vol 27 No 10, 1984 pp 434-439

[Article by W. Fritzsch, D. Kochan, J. Schaller and H. J. Zander]

[Text] 0. Introduction

With respect to current conditions, the objective of manufacturing is to secure productivity with a high degree of use of available capacity and short workpiece throughput times. A */flexible/* [in italics] production system is required for products which are manufactured in small quantities to customer specifications as well as for the manufacture of products with frequently changing designs. This can be ensured by the basic technical system, the control system and system organization, however it requires new system designs which are characterized, in particular, by difficulty in controlling the information flow--a major problem considering the level of sophistication in automation.

The objective of this article is to present an analysis of control structures needed in the design of a flexible, largely automated manufacturing process, to describe the current state of equipment development, and to present an overview of ways in which control processes can be modeled. In addition, an attempt will be made to clearly define terms, some of which are interpreted differently in various technical disciplines, thus laying the groundwork for interdisciplinary cooperation.

1. Manufacturing System Requirements and Information Flow

We can distinguish between two phases in the manufacturing process: the production engineering phase and the actual processing phase. Manufacturing involves both organizational as well as technical processes.

The */manufacturing control system/* [in italics] (Fig. 1) is used to control the organizational processes. It is the job of this control system to initiate, monitor and reliably control the processing of manufacturing orders in terms of requirements (quantity, deadline), quality, cost and working conditions [2]. It is this system which also distributes the manufacturing orders among the manufacturing subsystems, i.e. machine cells, machines and equipment.

Technical processes are realized via the /process control/ [in italics] (Fig. 1). Because a complex machine cell always comprises sub-processes TP_{n_j} , which are performed on a variety of equipment such as machine tools, robots, transport systems, transfer stations, palletizing stations, measuring stations, waste processing stations and the like, the process control for one machine cell can be subdivided into sub-controls SE_{n_j} for the individual sub-processes. A process computer or a micro-process computer SE can be used to coordinate all of these sub-processes. This computer, in turn, receives its instructions from the master production control system.

The production engineering phase of the manufacturing process deals with the design of the products to be manufactured, technical preliminary work and optimization of the manufacturing process, process engineering, the laying-out of processing sequences (switching and position-dependent operations) to accomplish the technical manufacturing sequences and subsequent programming of the equipment which will control the entire process.

In /process engineering/ [in italics], manufacturing objectives are set and the manufacturing tasks necessary to achieve these objectives are formulated [2]. Thus process engineering defines the task(s) of the production control system. In a similar way, the /process control layout/ [in italics] determines the tasks to be performed by the process control.

The diagram in Fig. 1 shows two paths of information flow:

- Information flow from the production engineering phase to the actual processing phase (horizontal path). This information path is an open chain of information. The computers used in the chain presently operate primarily off-line. In a subsequent phase, manufacturing data can be collected and evaluated.
- Information flow between the production control equipment, the process control equipment and the process (vertical path). This information always flows in two directions (command and acknowledgement). The computers used for handling this information operate primarily on-line (CAM).

Fig. 2 provides an overview of manufacturing data flow. In many instances separate flows of information have developed in the enterprises and combines as a result of management structure. In order to ensure flexibility, these technical information circuits must be integrated with the business management information circuits to the greatest extent possible. The link joining these two information groups could be the collection of operational data. From a cybernetic point of view, intertwined structures must be separated from one another, for example according to the Japanese Kanaban principle of decentralized production control [3].

With regard to full automation of all sub-tasks through the use of EDP systems, stored-program control systems and microprocessor-based computers, data continuity along the horizontal and vertical paths (Fig. 1) plays an important role. This requires that the various steps of the process be algorithmically set up during the engineering phase, as well as modeling of the process

sequences during the actual processing phase. The sequences of events in manufacturing processes can be characterized as series of actions. These actions can take the form either of spatial movements (travel functions) or general switching events (switching functions), and are triggered by position-dependent or switching instructions. Binary sequence controls (such as programmable or PC controls) are used to interpret and carry out switching instructions. The coordinates for the various sequences of movements initiated by point-to-point, straight cut or contouring controls are defined and controlled by numerical values. NC controllers were developed for the processing of this numerical data flow, and today all of them are equipped with microprocessor-based computers as CNC controllers.

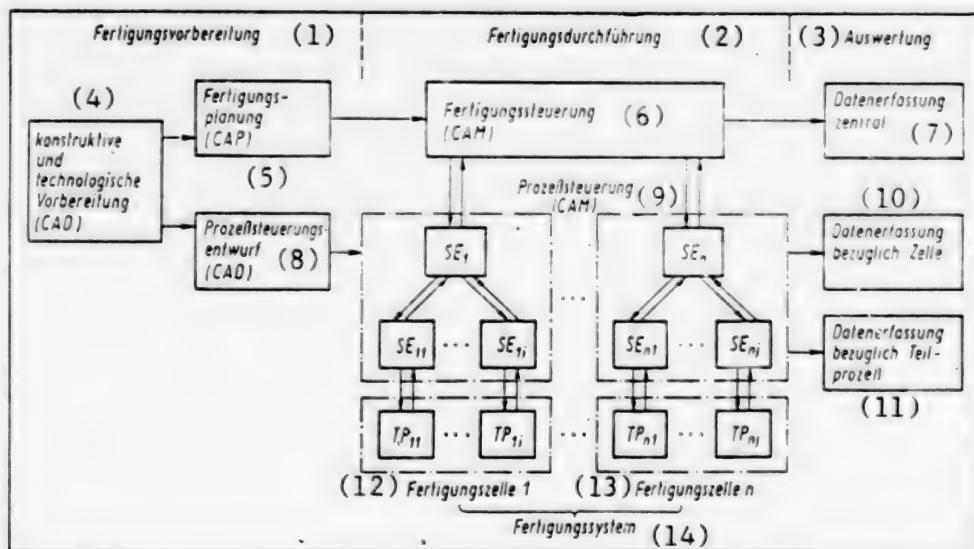


Fig. 1. Tasks During the Engineering and Process Phases of Production

Key:

1. Production Engineering	8. Process Control Layout
2. Processing	9. Process Control (CAM)
3. Evaluation	10. Cell Data Acquisition
4. Preparatory Design and Technical Activity (CAD)	11. Sub-Process Data Acquisition
5. Process Engineering	12. Machine Cell 1
6. Manufacturing Control System (CAM)	13. Machine Cell n
7. Centralized Data Acquisition	14. Manufacturing System

Currently technical functions are being integrated through the use of CAD/CAM equipment. The purpose of such integration is to establish a network incorporating various different functional areas based on one common database in

order to avoid to as great an extent as possible the repetitive use of edited data or source data in the establishment of new models. This requires:

- Layout, design and drawing activities
- Technical calculations in the design process
- Generation of parts lists
- product engineering activities
- Production of NC programs

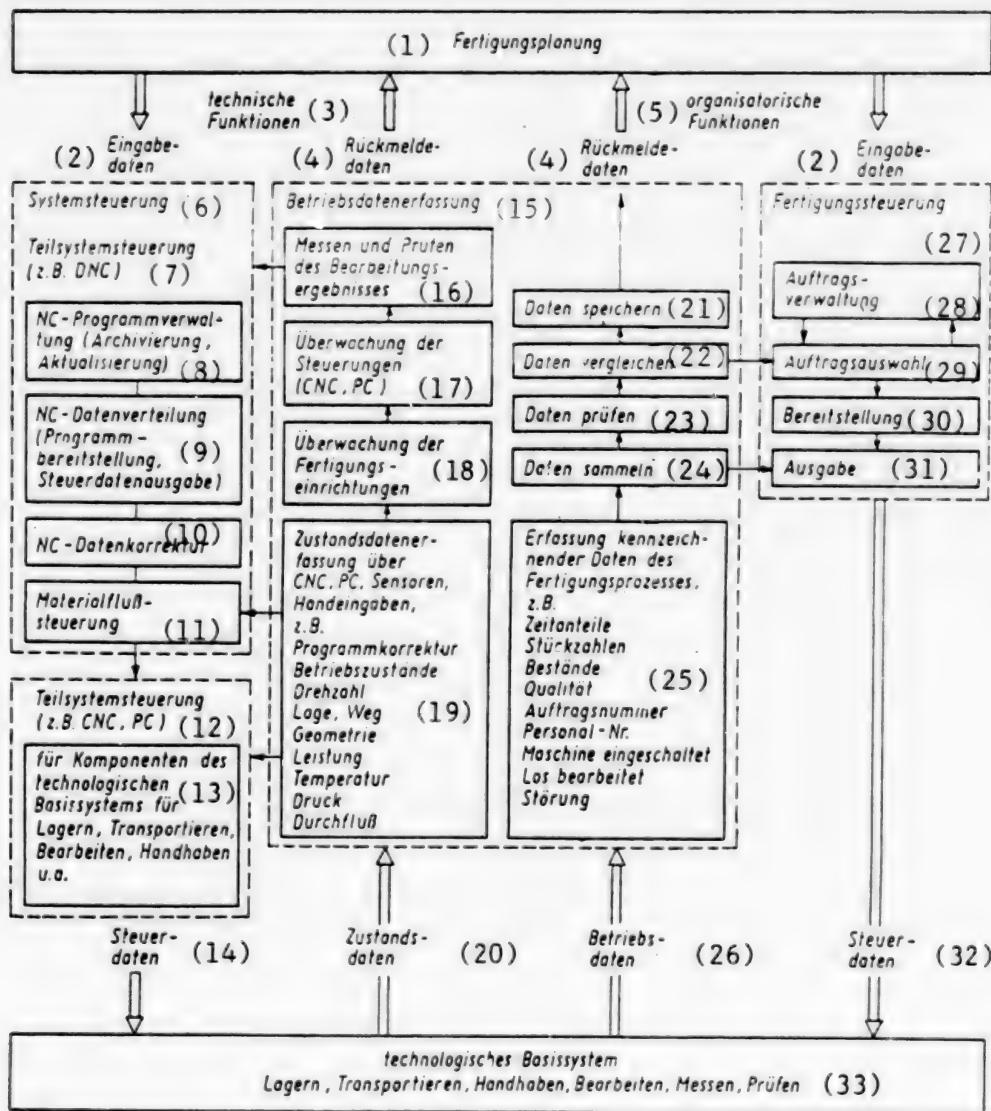


Fig. 2. Manufacturing Data Flow

Key:

1. Process Engineering
2. Input Data
3. Technical Functions
4. Acknowledgement Data
5. Organizational Functions
6. System Control
7. Subsystem Control (e.g. DNC)
8. NC Program Administration (e.g. filing, updating)
9. NC Data Distribution (program activation, control data output)
10. NC Data Correction
11. Material Flow Control
12. Subsystem control (e.g. CNC, PC)
13. For Components of the Basic Technical System for Storage, Transport, Processing, Handling, etc.
14. Control Data
15. Operational Data Acquisition
16. Measurement and Checking of Processing Results
17. Control Monitoring (CNC, PC)
18. Monitoring of Manufacturing Equipment
19. Acquisition of Status Data via CNC, PC, Sensors, Manual Inputs, e.g. Program Correction, Operating Conditions, Rotational Speed, Position, Travel, Geometry, Power Output, Temperature, Pressure, Flow Rate
20. Status Data
21. Store Data
22. Compare Data
23. Check Data
24. Collect Data
25. Acquisition of Identifying Data, e.g. Percentage of Processing Time, Quantity, Stocks, Quality, Job Number, Personnel Number, Machine On, Lot Processed, Malfunction
26. Operational Data
27. Manufacturing Control System
28. Job Management
29. Job Selection
30. Activation
31. Output
32. Control Data
33. Basic Technical System; Storage, Transport, Handling, Processing, Measuring, Checking

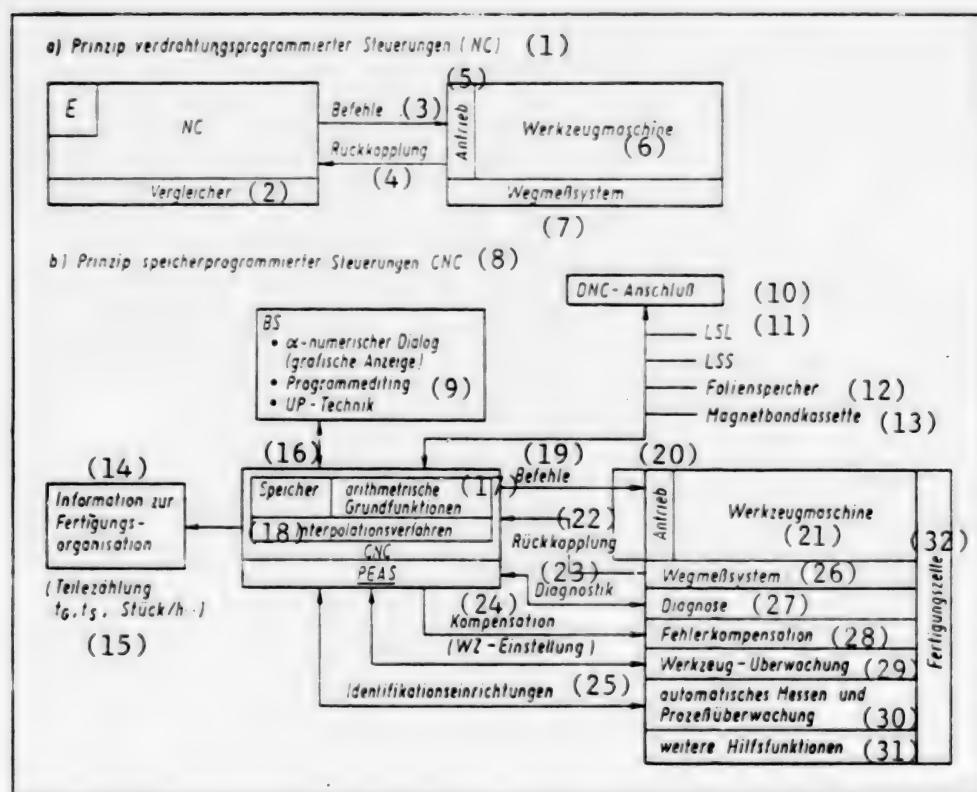


Fig. 3. Principles of Programmable Controllers

a) hardware-programmed NC controller
 b) stored-program CNC controller

Key:

1. a) Operation of Hardware-Programmed Controllers (NC)	16. Memory
2. Comparator	16. (Counting of Parts t_G, t_S , pieces/h ...)
3. Commands	17. Basic Arithmetic Functions
4. Feedback	18. Interpolation Process
5. Drive	19. Commands
6. Machine Tool	20. Drive
7. Path Measuring System	21. Machine Tool
8. b) Operation of Stored-Program Controllers (CNC)	22. Feedback
9. OS	23. Diagnostics
<ul style="list-style-type: none"> • alphanumeric dialog (graphic display) • program editing • microprocessor technology 	24. Compensation (tool setting)
	25. Identification Equipment
	26. Path Measuring System
	27. Diagnosis

10. DNC Interface	28. Error Compensation
11. High-Level Logic	29. Tool Monitoring
12. Foil Storage Device	30. Automatic Measuring and Process Monitoring
13. Cassette Tape	31. Additional Auxiliary Functions
14. Information for Manufacturing Organization	32. Machine Cell

2. State of Development of Control Engineering

2.1. /CNC Controllers/ [in italics]

If one compares the functional content of hardware-programmed NC controllers (Fig. 3a) with that of stored-program CNC controllers (Fig. 3b), it can be seen that CNC controllers can handle a much more comprehensive group of tasks than NC controllers, given equal basic requirements for each type.

Fig. 3b illustrates the most important task groups currently required for the control of machine cells which are practical to implement. The scope of functions illustrated can be currently performed by internationally known CNC controllers, among them the CNC 600-3.

It can thus be seen that stored-program CNC controllers have reached new levels of increased sophistication with regard to process control which are characterized by the following features:

- Intelligent operator support
- Powerful and expandable function groups in process automation
- Potential for assuming sub-tasks in manufacturing control and organization
- Coupling and communication potential with master computer systems or peripherals

These characteristics and features allow CNC controllers designed for the flexible control of machine tools to simultaneously be used for other industrial control tasks in which point-to-point movement is required. This capability is evidenced by the fact that CNC controllers or specially equipped and modified versions of CNC controllers are currently being used for the performance of ancillary tasks in the comprehensive automation of discrete production processes such as the control of transport systems (crane installations).

Table 1 gives an overview of those systems available in the GDR for the control of production facilities.

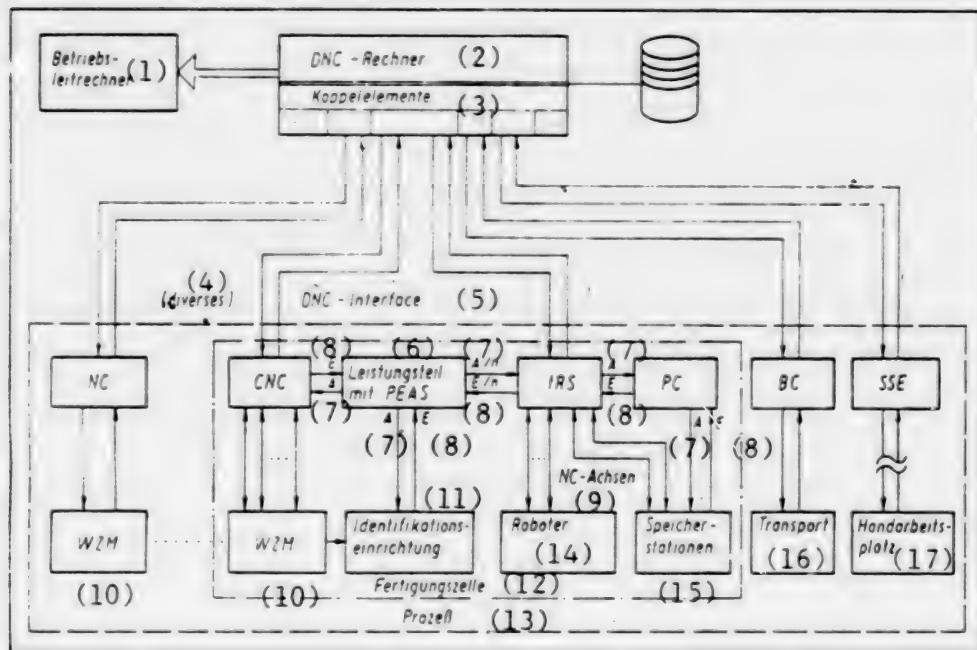


Fig. 4. Direct Numerical Control (DNC)

Key:

1. Master Computer	10. Machine Tool
2. DNC Computer	11. Identification Equipment
3. Couplers	12. Machine Cell
4. (various)	13. Process
5. DNC Interface	14. Robot
6. Output Section with PEAS	15. Storage Stations
7. Output	16. Transport
8. Input	17. Manual Work Station
9. NC Axes	

Table 1. Control Systems for Production Facilities in the GDR (as of 1984)

System	Use	Axes of Control	Form of Interpolation	Resolution	Components/ micro-computer-based	Memory Workpiece program memory	Memory techni- cal part programs	Program input/ program output	Scope of functions
CNC 600-1	milling drilling	X,Y,Z 4th and 5th axis	3-D linear helix	0.001 mm 0.001°	8 Kbyte CMOS RAM, or 12.2 Kbyte or 28 Kbyte DRAM, un- supported	3 Kbyte + 4 Kbyte CMOS RAM, CRT screen, DNC system operation	external rester/punch, CRT screen, DNC system operation	● workpiece programming ● absolute and concatenated programming ● service pro- gramming ● machine-rated PMC	● workpiece programming ● expanded NC programming ● expanded computing capability ● workpiece control via 3-D probe ● tool down- time mon- itoring
turning	X,Y	2-D linear circular helix		0.001 mm		7 Kbyte CMOS RAM	6 Kbyte		
CNC 600-3	milling drilling turning	measurement system and 5th axis for position	analogous to CNC 600-1	analogous to CNC 600-1	8 Kbyte CMOS RAM, suppor ted, 16 Kbyte or 32 Kbyte DRAM	measurement system for main spin- dle during thread cutting or spindle adjustment	analogous to CNC 600-1	● expanded NC programming ● expanded computing capability ● workpiece control via 3-D probe ● tool down- time mon- itoring	

- listing of
 - tool memories (pallet number)
 - automatic pallet change
 - process data acquisition
 - degree of machine use
 - real-time clock
 - piece processing time
 - time of use
 - workpiece counting
 - travel-dependent lubrication

N/C-H 642	point-to-point position-	X, Y, Z	2 1/2-D linear interpolation	(360°/2000) (360°/20,000)	2 Kbyte or 8 Kbyte in EPROM supported RAM or EPROM as plug-in cartridge	4 Kbyte in EPROM	manual entry, carriage tape reader and external tape punch	● process oriented program preparation/automatic programming	● program manipulation via sophisticated microprocessor technology
N/C-H 645	contouring control for lathes	X, Z/thread cutting	2-D linear and circular interpolation	0.001 mm	● correction of position-dependent ma-				

CNC-H 646 contour-
ing con-
trol for
milling
machines
and pro-
cessing
centers

- chine toler-
ances
- travel-depen-
dent lubrica-
tion of ways
- programmable
end position
monitoring
- via software
limit switch-
es

PC 600 provides 480 inputs/
control outputs not
signals multiplexed,
for ma-
chines 640 inputs/
outputs mul-
tiplexed
processes
used in
machine
tools,
clock-con-
trolled
lines and
special
machines

cycle time t_Z
(t_{RSE})
 $10 \text{ ms} \leq t_Z \leq 160 \text{ ms}$
($3 \text{ ms} \leq t_{RSE} \leq 10 \text{ ms}$)
fast input

PC 601 max. 8 Kbyte
PC 602 } max.
PC 603 } 16 Kbyte
expandable in blocks
of 1 Kbyte each

PRG 600 programming
unit

commands:
AND, OR, NOT,
multiple levels
of parentheses,
conditional
branch, addi-
tion, subtrac-
tion, multi-
plication, divi-
sion, compari-
son (, =,),
counters, shift
registers

IRS 600 robot
control
for 3 NC
axes

5 axes, of
which 3 are
NC axes

axes with
point-to
point op-
eration

3 Kbyte
CMOS RAM

teach-in
programming

● program mod-
ules for man-
ipulator
movements

● diagnostic
routines

IRS 2000 robot control for 2 servohydraulic axes 5 axes with 30 programmable positions linear film potentiometer 0.1 mm cycle time: 18 ms U 808 processor family 4 Kbyte EPROM

- commissioning and programming sequences of movement
- simultaneous operation of all 5 axes
- number of commands: 20

2.2 /DNC Controllers/ [in italics]

The direct numerical controller (DNC) is well suited to automation of many different kinds of manufacturing processes (Fig. 4). The DNC principle is characterized by on-line data supply to several numerically controlled processing stations by a central process computer. The data transmission procedures permit use of the contention mode and the coupling of the required technical information flow to organizational parameters. These are the primary information processing and manufacturing control requirements for manufacturing automation by means of basic and expanded DNC functions in modern, flexible manufacturing systems. With the increasing application of stored-program controls, the DNC process is incrementally released from the time-critical symbol-by-symbol and record-by-record formatted basic mode of operation so that it can be used for other monitoring tasks. This applies above all to the integration of processing-oriented functions, programs for robot controls, measuring stations, pallet and transfer stations for work-pieces and tools, rinsing and cleaning procedures as well as disposal procedures for process materials. These tasks can be performed in modern machine cells with a minimum of operating personnel, and expand to include material flow control between the machine cells as well as the manual work stations.

In accordance with the historical development process, DNC evolved from the technical information flow as a paperless way of distributing data from the production engineering phase to actual processing. Through the ability to provide real-time information, DNC is suited to centralizable tasks of manufacturing supervision. In addition to machine tool supervisory functions, the automated, minimum-personnel manufacturing process also requires process-monitoring tasks such as

- tool and tool wear control
- workpiece monitoring
- processing supervision
- monitoring of manufacturing quality.

These monitoring and supervisory functions can be implemented through the use of process-oriented identification equipment. The process models must through proper selection pass information to the DNC computer and must modify internal machine manipulated variables as the situation requires. By keeping and updating statistics and trends concerning the development and drift of the process by means of polling, the DNC computer can provide a good real-time picture of the manufacturing process, the identification model of a flexible manufacturing system. The identification model plays a significant role in the monitoring of the process and ensuring its reliability. It forms the basis of sequential control of the processing and auxiliary procedures and the material flow. These sequences must be realized as required by function, must overlap in time and space, and are subject to modification for technical and organizational reasons. Of importance here is the detection of possible collisions and situation-independent, conditional functions. The hierarchical position of the DNC computer is best adapted to such functions.

3. Modeling Manufacturing Processes

3.1. /Total Model/ [in italics]

The basis of every automation process is the establishment of suitable models. The theoretical treatment of systems and processes in manufacturing technology presents particularly difficult problems due to the high dimensionality. It is therefore practical to break the manufacturing process down into sub-processes and determine the total manufacturing objective by coordinating the individual objectives of the sub-processes (see Fig. 1). Table 2 shows one way of distributing the total manufacturing process among three subsystems, each of which is operated by a suitable control (microcomputer) to achieve its individual objective. These "sub-controls" answer to a coordinating control which coordinates the subsystem objectives to achieve the total manufacturing objective. Whether the controls are concentrated in one computer or are distributed among several subordinate computers and hierarchically structured in a multicomputer system is not the concern of the modeling process, but rather the control design. Only after the functional interrelationships (and thus the data flow) have been established is it possible to configure the control system (computer system).

3.2. /Modeling of Manufacturing Control Processes/ [in italics]

The modeling of manufacturing processes comprises the following process elements:

- Labor force
- Object to be processed
- Processing materials

These elements are expressed in terms of deadline and capacity scheduling as well as manufacturing control and monitoring.

Modeling makes use of simulated processes and real-time models. The /simulation models/ [in italics] precede the actual sequence of process events in time and anticipate the process in the form of physical, temporal and spacial determinations with regard to the process elements and the coordination of the sub-processes [4]. These models are recorded in the form of decision tables, graphical representations or Petri networks, whereby the random appearance of certain events or situations can be illustrated.

Models indicate primarily technical and mathematical causal relationships and targeted functions for optimum process preparation. Such targeted functions can include:

- Minimum manufacturing time
- Minimum manufacturing costs
- Ensuring reliability of a chip shape class.

These objectives are determined by varying manufacturing variables, such as feed and cutting speed, within a restrictive solution field. With the help of

modern equipment design, real-time acquisition of process conditions in the course of coordinated processing with the manufacturing program is also enabled, thereby making new solutions possible.

Process supervision and the conceptualizing of manufacturing processes are possible through the use of real-time models. On-line closed-circuit process control in manufacturing is not yet advanced enough for broad implementation. Therefore real-time models (identification models) have rarely been used to date.

3.3. */Modeling of Process Controls/* [in italics]

In designing a process control (see Fig. 1) the control task--the behavior to be implemented by the control--must be appropriately defined by using logic expressions or functional diagrams, for example. These methods are used not only to describe control equipment behavior, but also form the basis for interconnection of the link-programmed controls, because by indicating the logic units involved and the interconnections to be implemented between them, they contain the structural information necessary for the required cable connections between pieces of equipment as well as information on control behavior (description at the structural level).

Table 2. Modeling Approach: Breakdown of a Large Manufacturing System into Subsystems; Listing of Process Control Objectives

Subsystem	Subsystem	Subsystem
Products Workpieces	Manufacturing Process	Technical equipment Materials
Operands	Operations	Operations
Output: Manufacturing job (geometrical definition of the part to be man- ufactured) Determination of all processing operations for part manufacture Solution aids: NC programming systems Results: Part-oriented manufac- turing program Output: Work schedule, compar- ison between desired and actual processing conditions	Distribution of proces- sing operations among individual machines (processing units) Result: Manufacturing program oriented toward manu- facturing system Machine-oriented pro- cessing operations in chronological sequence	Machine-oriented adap- tation of neutral man- ufacturing data Travel path transfor- mations Adaptation of control commands Collision investigation

Individual objective:
processing development
→ maximum
• no non-productive
workpiece time

Individual objective:
machine occupation
→ optimum
• technologically-
dependent processing
sequence
• high degree of use of
available capacity

Individual objective:
rate of machine use
→ maximum
• optimum processing
times (tool life)
• ensuring reliability
of a specific chip
shape class
• no downtimes (machine
malfunctions)
• no scrap

overall manufacturing objective to be achieved through coordination of the sub-objectives of the subsystems:

throughput time → minimum
manufacturing costs → minimum

In the case of stored-program controls, functional diagrams or logic expressions can of course also be utilized as the starting point for preparing the programs, although here the structure information is not of primary interest. Here it is entirely sufficient and even desirable to describe only the behavior of the control to be implemented. Methods suitable for such a description can take the form of tables, graphical representations or series of symbols. Graphical descriptors are particularly effective for the primary notation of control tasks. Examples of such graphical methods of representation are [5]:

- Graphic representations of automatic machines
- Program flowcharts
- Petri networks
- Logic diagrams

However compact task notation can also be achieved under certain circumstances by using tabular descriptive methods such as sequence tables or decision tables. A comprehensive evaluation of the various methods of description is presented in [6].

In principle, assembly language can be used to convert the descriptions into a program for a stored-program control. It is more favorable, however, to use a special- or technical-oriented language which permits direct use of structural or behavioral descriptions by means of a compiler or interpreter.

There are several technical-oriented languages in use in the GDR for handling the above tasks at the level of structural description. These are:

- Logic-oriented language for the PS 2000 [7]
- Module-oriented PROLOG 1/2 for the ursalog 5010/5020 [9]
- Technical-oriented language based on Boolean operations for the PC 600 [8].

The following technical-oriented languages at the level of behavior description (graphics-oriented) are available from technical schools or academies:

- For program flowcharts: MAKRO-FAST [10]
- For Petri networks: SGM [11], PSI [12]
- For logic diagrams: FUP [13].

Since such actions are of particular importance in the modeling of process controls for manufacturing systems and have as their objective the performance of movements between given points in space, stand-alone technical-oriented languages were developed in concert with international standards for the purpose of performing these sub-tasks (CNC controllers). These languages allow direct programming of the workpiece contours and feed speeds (e.g. CNC-H 600 [14]). Corresponding technical-oriented languages also have been developed for text programming of robots.

Concluding Remarks

This discussion represents an attempt to analyze problems involved with minimum-personnel production engineering from the viewpoint of production engineering as well as from the viewpoint of automation technology, and to illustrate approaches to the solution of such problems. The effective solution of these problems will only be possible through close interdisciplinary cooperation between production engineers and automation engineers.

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GERMAN DEMOCRATIC REPUBLIC

CAD SYSTEMS FOR ELECTRONIC COMPONENT DESIGN REVIEWED

East Berlin MESSEN STEUERN REGELN in German Vol 27 No 10, 1984 pp 439-446

[Article by Prof Dr Siegfried Pilz, Engineer]

[Text] 0. Introduction

With the constant growth in production quantity and quality requirements the scope of automation tasks broadened, bringing about an exponential increase in the complexity of industrial measuring, control and regulating systems. Operational reliability, maintenance and service processes could only be ensured by virtue of the simultaneous development of miniaturization and integration of the necessary electronic and mechanical [1] components and functional units. Through these developmental processes a significant improvement in the cost/performance ratio of the equipment was attained--by a factor of 1000, for example, in the case of computer hardware. "Software technology," however, was unable to keep pace with this growth in the cost/performance ratio and the attendant increase in equipment performance, as the cost/performance ratio in computer software has only grown by a factor of 4 to 7. This development is known to all in the business as a "software crisis" or as an acute lack of layout, development and planning capability (Table 1). This lack lead in general to the development of computer-aided engineering (CAE) and in particular computer-aided design (CAD; see Fig. 1); efforts are under way to integrate this new field of technical endeavor into the field of computer-aided manufacturing (CAM). In general, however, this means nothing more than the engineering requirement to develop automation of non-material processes for material production.

1. Hierarchy of the Item to be Designed

The item to be designed determines the process technology to be used, i.e. the design methods and technology. These methods and technology determine the requirements to be met by the software technology, which in turn is closely associated with the hardware technology, the quality of which together with the software technology determines to a great extent the quality of communication between the designer and the CAD system, and therefore the effectiveness of the design (interactive communication: menu and manipulation techniques). In accordance with the state of the art of highly-integrated circuitry, an electronic device as an item to be designed must be viewed as a system whose major

Table 1. Overview of Terms Used in Non-Material Pre-Production Processes

Term	Objective	Item to be Processed in Terms of Dimensioning or Instrumentation (Hardware Hierarchy)	Result
Design (functional structuring)	Determination of: - Overall function - Function sequences - Breakdown into sub-functions - Connections between subfunctions - Principal realization	- Functional element - Functional group - Functional unit - Device - Device group - System	Specifications for the development, layout or planning process
Development (technical structuring)	Technical dimensioning: - Structures - Connections - Hardware details - Software details - Methodical and technological details	- Components - Assembly - Unit - Hardware or hardware system - ----- - -----	Specifications for manufacturing processes
Layout (geometrical shape)	Determination of: - Geometrical shape - Detailed shapes - Geometrical dimensions - Processing quality	- Components - Assembly - Unit - Device (plug-in module) - Device group (cabinet) - System (cabinets, cable ducts)	Specifications for construction and assembly processes
Planning (technological structuring)	Determination of: - Overall configuration - Test and regulation points - Technological interface - Detailed instrumentation - Connections - Burn-in specifications	- ----- - ----- - ----- - Device group - System	Specifications for construction and assembly processes

components are printed circuit boards and panels, as well as integrated circuits including the necessary software (see Fig. 2). Thus there are three primary hardware design items which can be hierarchically ordered (Fig. 3):

1. Overall system
2. Integrated circuits and function groups as subsystems
3. Printed circuit boards and panels as connection subsystems.

Special programming techniques and hardware configurations in the form of layout workstations are available for the computer-aided design of printed circuit boards and panels. These are described in [2].

In systems design, the objective of which is the breakdown of the overall task, basic hardware designs are worked out, e.g. which subsystems can be implemented as single-board systems, which are feasible as single chips and which will require multiple printed circuit boards. Single-chip designs then lead to the design of integrated circuits, which in the following will also be discussed, since subsystems can also be viewed as systems (Fig. 3) [3] to [13].

2. The Design Process as a Series of Representations and Decisions

The design process can be analyzed from the following points of view:

- general: a positive and problem-related series of decision-making processes with continuous dialectical interrelationships between
 - function ↔ structure
 - synthesis ↔ analysis
 - representation ↔ testing (checking, inverse representation)
 - (Figs. 4, 5 and 6)
- technical: an iterative process for determination and continuous structural detail with simultaneous checking for functional invariance (Fig. 6)
- mathematical: an iterative series of representations in which optimum determination of model-oriented and free parameters is generated within the descriptive system of equations (which describes the physical and technical content; see Table 2)
- technological: a series of sub-processes which should form technological units where possible and whose communication quality plays a decisive role in determining the quality and effectiveness of the design.

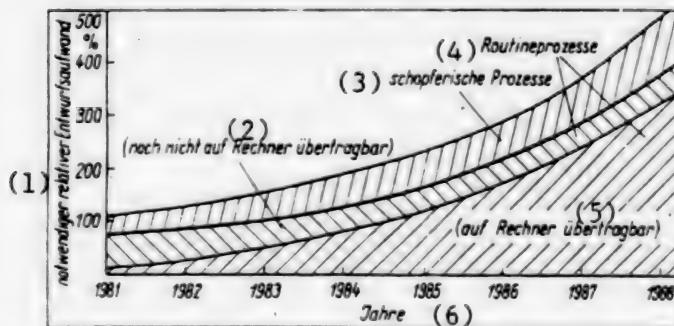


Fig. 1. Development Cost Trends Lead to the Necessity of Using Computer-Aided Design Methods

Key:

1. Necessary Relative Design Cost	4. Routine Processes
2. Not Yet Suitable for CAD	5. Suitable for CAD
3. Creative Processes	6. Year

The design process necessarily incorporates various iterative loops within the individual sub-processes as well as retroactive loops which cover one or more sub-processes (Fig. 6). The conclusion of one sub-process is generally the prerequisite for transition to the next sub-process, i.e. parallel sub-process execution is only possible to a limited degree. The greater the extent to which these sub-processes and the items to be designed can be standardized (e.g. through regularity and repetitive structures--Fig. 7), the greater the possibility of parallel execution or shortening the process by omitting design steps.

Processing quality within a certain sub-process directly affects processing within subsequent sub-processes and the number of required iterations. Normally sub-processes are run through various degrees of detail, however they must always be adapted to a defined transfer interface.

The "function → structure" representations (in the mathematical sense: generalized representations and relationships) indicate processes of synthesis and in general have several meanings. Their CAD implementation is therefore practically only feasible in the interactive communication mode, whereby as uniquely defined criteria as possible, technological rules of design and standard recommendations permit the limitation of ambiguities, support the decisions of the designer and increase the effectiveness of interactive communication.

The "structure → function" representations indicate analysis procedures, and in general are unambiguous. They are normally batch-processed in practice in CAD via relatively complex simulation programs.

The representations in the various individual design stages are at present at different levels of development, i.e. the extent to which they can be implemented by means of mathematical algorithms. For this reason, the layout geometry of individual CAD planes, for example, can now be automatically converted to control information for use by the image generators in laying out integrated circuits (CAI), while system design, for example, is at present still a more or less intuitive merging of known databases with databases to be newly generated for special design purposes. Interactive communication with the computer in the form of user-friendly menus and manipulation techniques based on unambiguous mathematical descriptions and their equivalent transformations forms the principal advantage of the CAD procedure in the case of such synthesis processes [3] to [13].

As far as its internal structure is concerned, the software technology of a CAD system is therefore designed as an open system of largely autonomous program systems in order to allow necessary user expansion and supplementation. This free CAD system access is also a necessary prerequisite for ensuring adaptability to advanced design and manufacturing requirements, operative and defined retrieval of current designs from the design process, reentry of such designs, or reassimilation and further mechanical processing of intuitively generated designs, regardless of the stage of completeness which they have reached.

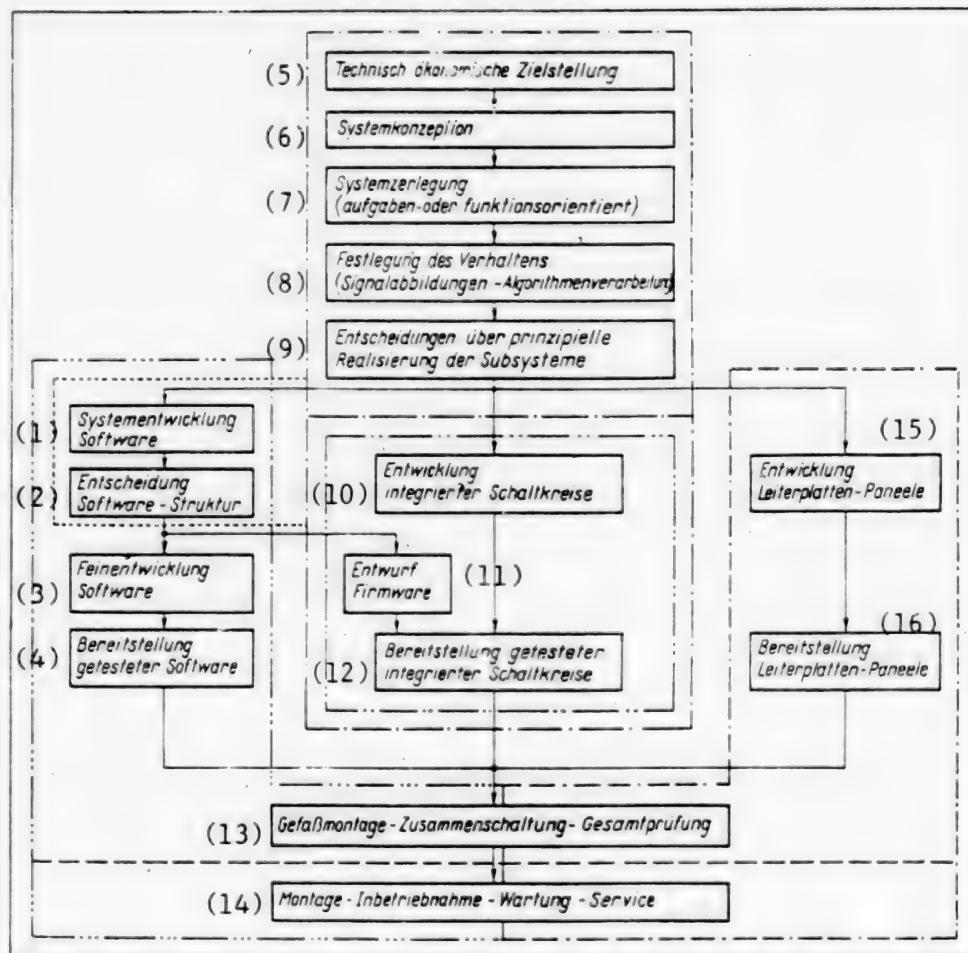


Fig. 2. Overview of Overall Design

Key:

1. System Development Software
2. Decision Software Structure
3. Detailed Development Software
4. Provision of Tested Software
5. Technically Economical Objective
6. System Concept
7. System Breakdown (task- or function-oriented)
8. Determination of Behavior (signal representations - algorithm processing)
9. Decisions on Basic Subsystem Implementation
10. Development of Integrated Circuits
11. Firmware Design
12. Provision of Tested Integrated Circuits
13. Container Assembly - Hookup Overall Testing
14. Assembly - Commissioning - Maintenance - Service
15. Development of Printed Circuit Boards - Panels
16. Provision of PC Boards - Panels

(1) geratetechnische Hierarchy	Hierarchie der (11) Entwurfsbearbeitung	Beispiele (17)	Darstellungsebene (27)	Großenrelationen (37)	
				in BE (38)	in mm
(2) Anlage	(12)	EDV-Anlage (18) Automatisierungssystem (19)	Anlagenblockstruktur (28)	$10^6 \dots 10^{10}$	10^4
(3) Gerät	(13)	Zentraleinheit Prozeßrechner (19)	Geräteblockstruktur (29)	$10^7 \dots 10^9$	10^3
(4) Panel/ Halbpanel		System von Mikrorechnern große Speichereinheit (20)	Gerätefeinstruktur (30)	$10^5 \dots 10^8$	$10^2 \dots 10^3$
(5) Leiterplatte		Mikrorechner Speichereinheit (21)	Funktionsgruppenstruktur (31)	$10^5 \dots 10^7$	10^2
(6) integrierter Schaltkreis		Mikroprozessor RAM, PROM, ROM (22)	Chipstruktur, als Grobtopologie (32)	$10^3 \dots 10^6$	10^1
(7) Zelle		Register, Zähler ALU, Addereinheit (23)	Zellentopologie (33)	$10^1 \dots 10^3$	10^0
(8) Grundstruktur	(16)	Flip-Flop, Halbadder Gate, Logikeinheit (24)	Detailtopologie (34)	$10^0 \dots 10^1$	10^{-2}
(9) Bauelemente- struktur	Bearbeitung in den weiteren Entwurfsstufen	Transistor, Widerstand Leitung (25)	Detailtopologie (35)	10^0	10^{-3}
(10) Layoutfigur		Layoutfläche (26)	Detailtopologie (36)	$10^{-1} \dots 10^0$	10^{-4}

Fig. 3. Overview of CAD Hierarchy

Key:

1. Hardware Hierarchy
2. System
3. Device
4. Panel/Half-Panel
5. Plug-In Card
6. Integrated Circuit
7. Cell
8. Basic Structure
9. Component Structure
10. Layout Figure
11. Design Processing Hierarchy
12. Plane
13. System Environment
(hypersystem)
14. System
15. Subsystem
16. Processing in Subsequent Design
Phases
20. System of Microcomputers
High Storage Capacity
21. Microcomputer
Memory Unit
22. Microprocessor
RAM, PROM, ROM
23. Registers, Counters
ALU, Digital Adder
24. Flip-Flop, Half Adder,
Gate, Logic Unit
25. Transistor, Resistor
Electrical Lead
26. Layout Area
27. Representational Plane
28. System Block Structure
29. Hardware Block Structure
30. Detailed Hardware Structure
31. Function Group Structure

- 17. Examples
- 18. EDP System
- Automation System
- 19. Central Processing Unit
- Process Computer

- 32. Chip Structure as Rough Topology
- 33. Cell Topology
- 34. Detailed Topology

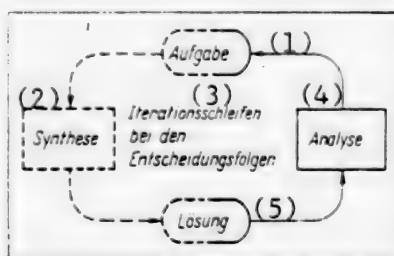


Fig. 4. Iteration Principle of the Decision-Making Process

---> representations with several meanings (a sufficient number of assessable decision criteria are necessary in order to limit the degree of variation)

→ unambiguous representations (assessment criteria are necessary)

Objectives: 1. Minimizing the number of iterations
 2. Minimizing the required iteration time, i.e. increasing the quality of the criteria, the algorithms and the methods used.

Key:

1. Task	4. Analysis
2. Synthesis	5. Solution
3. Iteration Loops in the Decision-Making Process	

3. The Design Process as a Technological Process

The design process can be modeled as a technological process (Fig. 8). At the same time, this model is a structural representation of the continuous communication between the designer and the CAD system. It is possible to view the active functional processing planes as a block diagram such as the one shown in Fig. 9, whereby the communication level is an EDP system with corresponding special peripherals. Such hardware must support alphanumeric and graphical input/output, must have interactive graphics or must at least permit quasi-graphic dialog, and must ensure appropriate comprehensive memory access in an effective and organized manner. The processing quality of the individual subprocesses can be classified according to the hardware and software capability of the CAD system (Table 3). The CAD hardware and software selected for the job should be only as extensive as necessary and not as extensive as possible, i.e. adapted to the design task at hand.

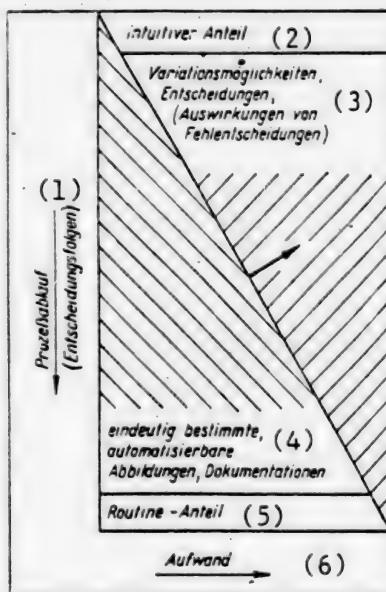


Fig. 5. Shifting of Mechanical Work (Computer-Aided) and Intuitive Work During the Course of Design

Key:

1. Process Execution (sequence of decisions)	4. Clearly Defined Representations and Documentation which can be Automated
2. Intuitive Portion	5. Routine Portion
3. Possibilities for Variation, De- cisions (effects of incorrect de- cisions)	6. Cost

Decisive criteria in the selection of hardware and software are the sub-processes to be processed, the necessary mathematical representations and procedures, as well as the software technology (Table 4). Graphic theory (Table 5), which must be supplemented by a comprehensive network description language (Table 10, [14] and [15]) which can be used in all design planes, has been shown in practice to be quite useful for the iterative mathematical processing of a design.

The technology of the design process has reached differing stages of development in today's various design offices. Table 6 presents an overview of the typical stages of development, whereby realization of stage 3 (in Table 6) requires not only the corresponding hardware and software, but also economically feasible implementation using today's microcomputer technology. Meeting these conditions, however, only fulfills the basic requirements. Only after all ergonomic aspects have been satisfactorily resolved and the so-called acceptance barrier has been overcome will it be possible to satisfy all of the necessary requirements for broad and successful application of effective CAD systems.

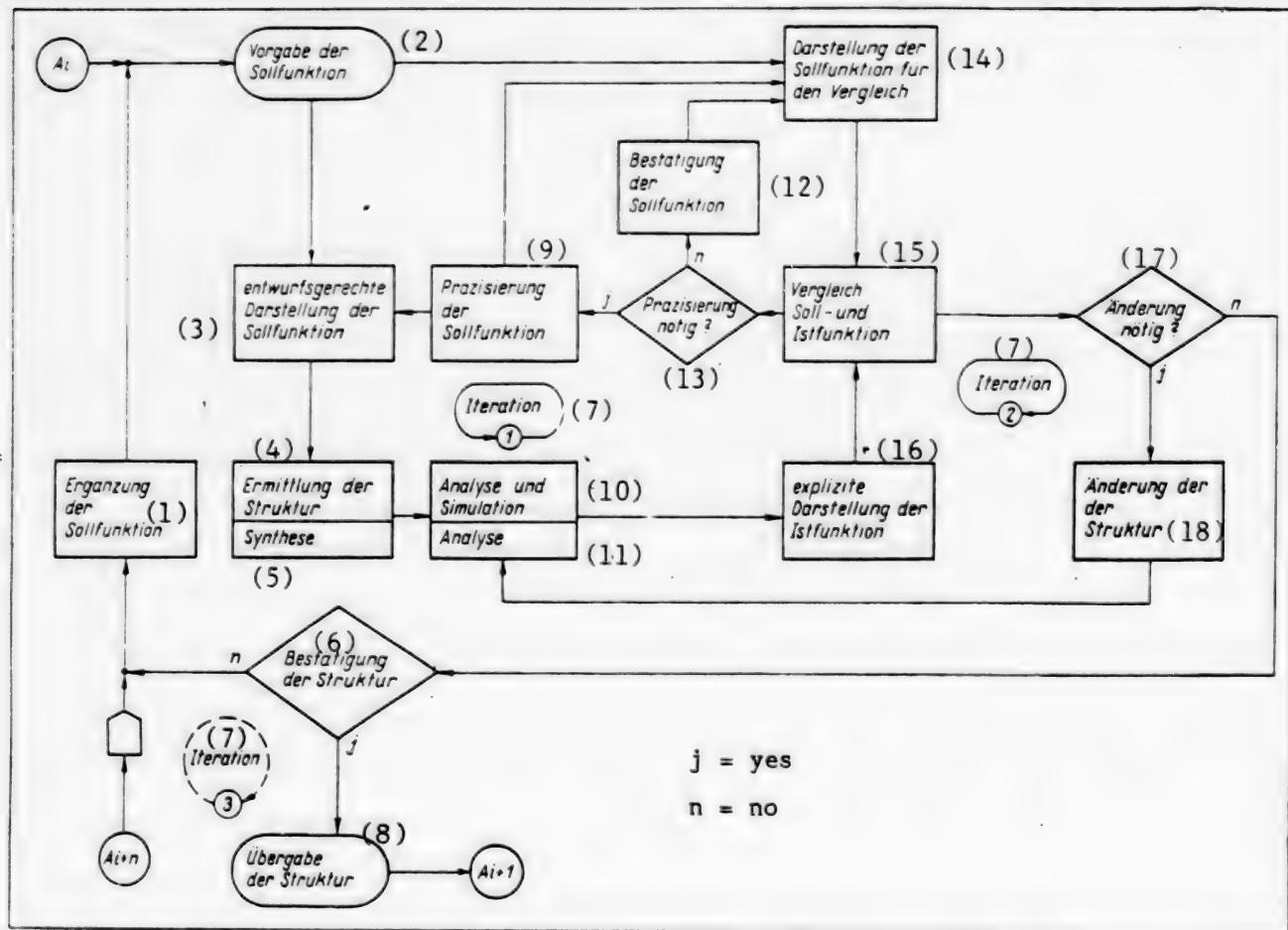


Fig. 6. Flow Diagram of the General Iterative Loops in the Various Design Stages

Key:

- 1. Supplementation of Nominal Function
- 2. Specification of Nominal Function
- 3. Design-Oriented Representation of Nominal Function.
- 4. Determination of Structure
- 5. Synthesis
- 6. Confirmation of Structure
- 7. Iteration
- 8. Transfer of Structure
- 9. More Precise Specification of Nominal Function
- 10. Analysis and Simulation
- 11. Analysis
- 12. Confirmation of Nominal Function
- 13. More Precise Specification Needed?
- 14. Representation of Nominal Function for Comparison
- 15. Comparison of Nominal and Actual Functions
- 16. Explicit Representation of Actual Function
- 17. Modification Necessary?
- 18. Modification of Structure

prinzipielle Struktur (1)	reguläre Strukturen in (21)		irreguläre Strukturen in (22)		(24)
	regulärer Anordnung (23)	irregulärer Anordnung (25)	regulärer Anordnung (23)	irregulärer Anordnung (25)	
(2) internationale Bezeichnung	Standardschaltkreise (22)	Halbkundenwunschschaltkreise (28)	Kundenwunschschaltkreise (26)	Kundenwunschschaltkreise (29)	(27)
(3) Beispiele	ROM, PROM, RAM, PLA (31)	Masterslice - SK (32)	SK aus Standardzellen (33)	applikationspezifische SK (30)	(30)
(4) Entwurfsstufen:	Entwurfsgrad I	Entwurfsgrad II	Entwurfsgrad III	Entwurfsgrad IV	(34)
(5) Technisch-ökonomische Zielstellung					
(6) Systementwurf					
(7) Systemsimulation					
(8) Systemruckerkennung					
(9) Logikentwurf					
(10) Logiksimulation einschließlich Fehlersimulation und Testdaten					
(11) Ruckerkennung der Logik-Netzwerke					
(12) Transistorentwurf elektrische Netzwerkanalyse					
(13) Ruckerkennung des elektrischen Netzwerkes					
(14) topologischer Entwurf					
(15) Zeilenlayout Verbundlayout					
(16) topologische Ruckerkennung					
(17) geometrische Kontrolle					
(18) Layout-File-Generation					
(19) Schablonen-/Maskenentwurf					
(20) Maskenkontrolle					

Fig. 7. Schematic Diagram of Computer-Aided Design Cost Shown as a Function of the Type of Circuit

Key:

1. Principle Structure	17. Geometry Check
2. International Designation	18. Layout File Generation
3. Examples:	19. Template/Mask Design
4. Design Stages	20. Mask Check
5. Technical/Economical Goals	21. Regular Structures in
6. System Design	22. Irregular Structures in
7. System Simulation	23. Regular Configuration
8. Reverse System Recognition	24. Irregular Configuration
9. Logic Design	25. Standard Circuits
10. Logic Simulation Including Fault Simulation and Test Records	26. Semi-Custom Circuits
11. Reverse Logic Network Recognition	27. Custom Circuits
12. Transistor Design	28. Masterslice Circuit
	29. Circuit Made From Standard Cells

13. Electrical Network Analysis	30. Application-Specific Circuit
14. Reverse Electrical Network	31. Design Stage I
Recognition	32. Design Stage II
15. Topological { Line Layout	33. Design Stage III
Design { Composite Layout	34. Design Stage IV
16. Reverse Topological Recognition	

4. Ergonomic Aspects of Computer-Aided Design

One of the keys to the effectiveness of CAD processes is interactive communication, i.e. alphanumeric and graphic dialog with the computer. Those who have spent many hours working at a video display terminal are well acquainted with the ergonomic problems associated with such work. The decisive technical and technological problem groups in this regard are:

- Sufficient technical capability
- Purposeful, task-related application
- Optimum application organization

The */technical capability/* [in italics] of video display terminals is governed primarily by the following:

- Overall ergonomic arrangement of the terminal workstation
- Operating speed of the video display terminal
[change of display, response time ≤ 1 s (max. 4 s)]
- Menu technique and number of available characters / quality of representation
- Capacity of screen for representation (CRT size and flicker-free scan or stability of raster scan)
- Ease of operation (function keyboard, graphics tablet, light pen, mouse)
- Manipulation software technique
- Scope, effectiveness and user-friendliness of the supplementary and problem solving software

The following are the main factors which contribute to the */purposeful, task-related use/* [in italics] of terminals, preparations for which must be made via a process-oriented cost/benefit analysis:

- Function-oriented use of certain different kinds of displays (see Table 4) such as:
 - alphanumeric, quasi-graphic and graphic displays
 - two or more colors
 - raster or vector principle

Table 2. Overview of Series of Representations in the Design Process (without Test Steps) for the System and the Integrated Circuits

Specification	Type of Representation	Description of Representation	Subject	Result
General task	Formalization (in concrete terms)	TEO Formulation	Technical/economical Objectives (TEO)	System specifications
System specifications (TEO)	Formalization (determination)	System design	Text (TEO) ↓ Control graphic (function)	System behavior
System behavior (function)	Structuring	Architectural design incl. software concept	Control graphic (function) Modulogram (structure)	System structure (subsystem specification), modular software system
Subsystem specification	Formalization (determination)	Automatic machine design	Modulogram (structure) ↓ Control (status) graphic	Subsystem function
Subsystem function	Structuring (breakdown)	Modular logic design	Control (status) graphic Modular logic diagram (MLD)	Subsystem structure
Subsystem structure	Detailed structuring	Detailed logic design	Modular logic diagram (MLD) ↓ Detailed logic diagram (DLD)	Logic diagram
Detailed logic design (function for ENW)	Compatible arrangement (structuring)	Transistor design	Detailed logic diagram (DLP) ↓ Circuit diagram (DGL)	Electrical Network (structure)
Electrical network (structure)	Compatible arrangement (structuring)	Layout design	Circuit diagram (DGL) ↓ Digital geometry (L)	Topography (layout structure)
Layout	Breakdown	Breakdown of planes	Digital geometry (L) ↓ Digital geometry (E)	Mask design

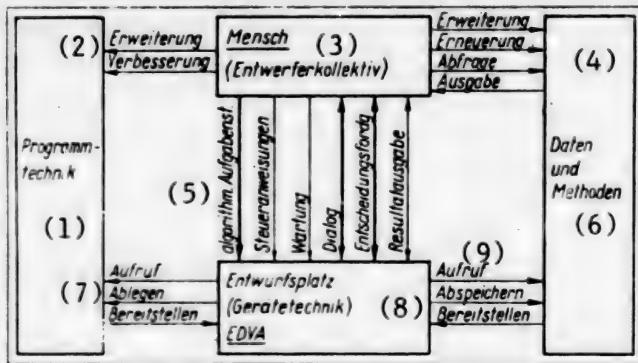


Fig. 8. Technological Model of the Design Process

Key:

1. Software technology	6. Data and Methods
2. Expansion	7. Call
Improvement	File
3. Man	Activate
(group of designers)	8. Design Workstation
4. Expansion	(hardware technology)
Replacement	EDP System
Scanning	9. Call
Output	Store
5. Algorithmic Task	Activate
Control Instructions	
Maintenance	
Interactive Communication	
Decision Requirement	
Output of Results	

Main processes (these processes are directly related to the manufacture of products which are typical for the enterprise; they determine the type of primary equipment used by the enterprises--in this case they are directly related to the preparation of the design and the corresponding documentation.)

Auxiliary processes (these processes are indirectly related to current design and support the main processes with which they are related.)

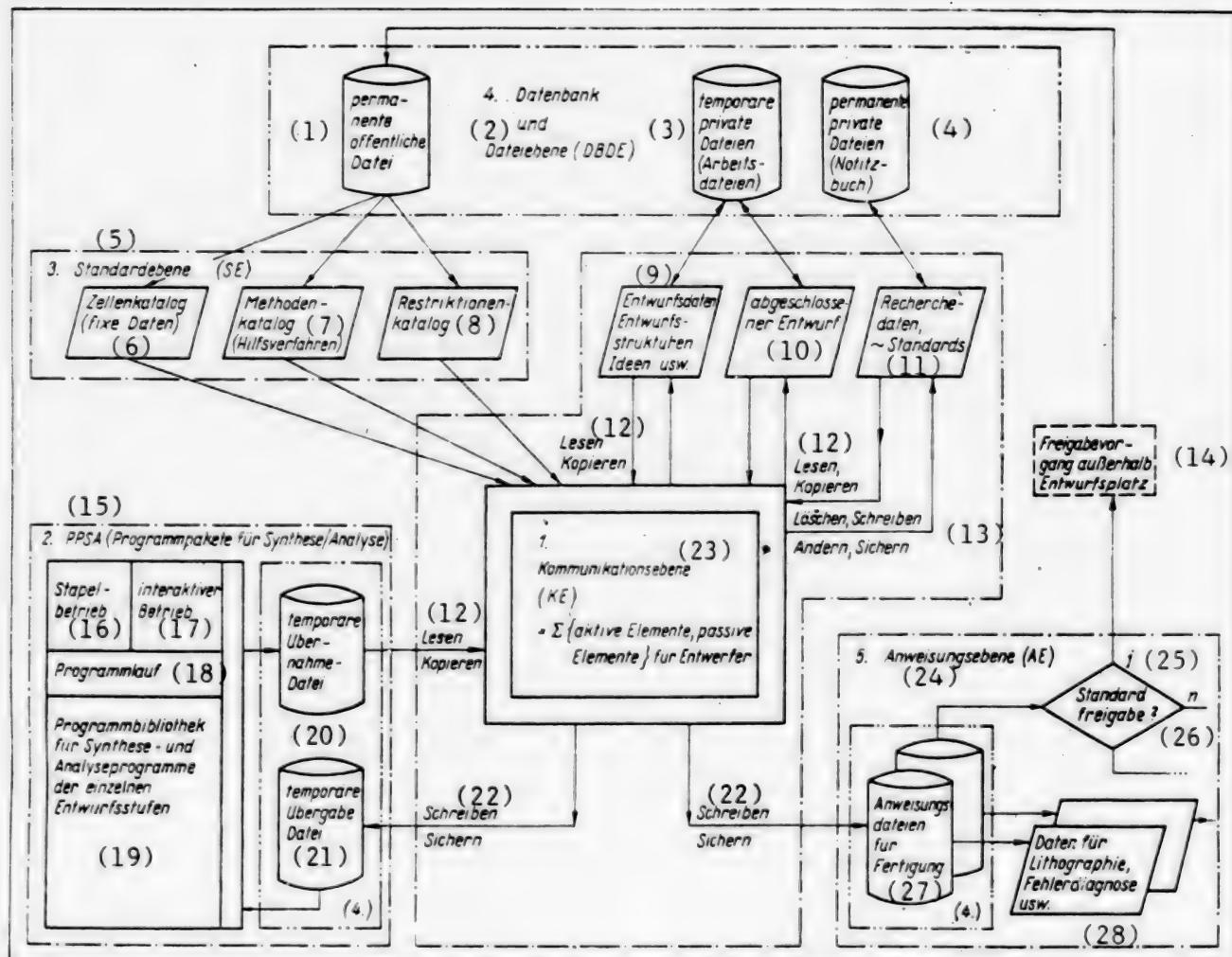


Fig. 9. Block Diagram of Functional Processing Planes (after Tanneberger)

Key:

1. Permanent Public File
2. Database and File Plane
3. Temporary private Files (processing files)
4. Permanent private Files (notebook)
5. Standard Plane
6. Cell Catalog (checkpoint data)
7. Methods Catalog (auxiliary methods)
8. Restrictions Catalog
15. Software Packages for Synthesis/Analysis
16. Batch Processing
17. Interactive Operation
18. Program Execution
19. Library for Synthesis and Analysis at the Individual Design Stages
20. Temporary Transfer File (incoming)
21. Temporary Transfer File (outgoing)

- 9. Design Data, Design Structures, Ideas, etc.
- 10. Finished Design
- 11. Research Data, Research Standards
- 12. Read Copy
- 13. Erase, Write, Change, Safeguard
- 14. Release Procedure Apart from Design Workstation
- 22. Write Safeguard
- 23. Communication Plane
 $= \sum \{ \text{active elements, passive elements} \}$ for designer
- 24. Instruction Plane
- 25. y
- 26. Standard Release?
- 27. Instruction Files for Manufacturing
- 28. Data for Lithography, Fault diagnosis, etc.

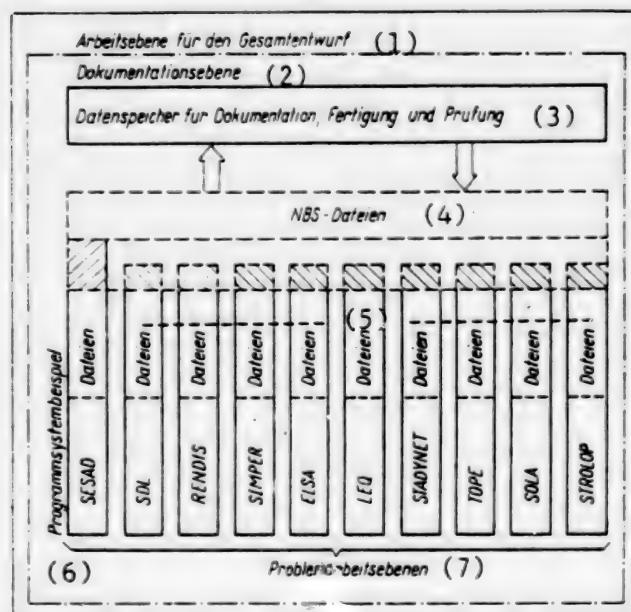


Fig. 10. Overview of the Individual Planes of Activity

Key:

1. Plane of Overall Design	4. NBS Files
2. Documentation Plane	5. Files
3. Data Storage for Documents, Manufacturing and Testing	6. Software System Example
	7. Problem Solving Planes

Table 3. Classification for Handling Sub-Processes

Processing Class	Processing Features	
B0	Trivial processing (without fixed processing sequence)	
BI	Manual - heuristic, intuitive processing (intuitive specification of a processing sequence - schematic orientation)	
BII	Intuitive, algorithmic processing (in some cases partially computer-aided) with algorithmic coarse processing sequence	
BIII	BIII.0	Fully algorithmized, computer-aided processing
	BIII.1	Fully algorithmized, alphanumeric display
	BIII.2	computer-aided interactive processing via quasi-graphic display
	BIII.3	graphic display
BIV	Automatic processing	

Table 4. Overview of Applications of Processing Classes

Sub-Processes	Descriptive Tools	Processing Classes
Technical-economical objective	Tables, diagrams, predicative information	BII
System design	Graphics, structural diagrams, networks	BIII.2/3
System simulation	Graphics, structural diagrams, networks	BIII.1/2
Logic design	Graphics, Boolean expressions, networks	BIII.1/2
Logic simulation	Graphics, Boolean expressions, networks	BIII.1
Design electrical network	Algebro-differential equations, networks	BIII.1/2/3
Simulation electrical network	Algebro-differential equations, networks	BIII.1/2
Layout design	Point sets, graphics, networks	BIII.3
Geometrical layout test	Point sets, graphics	BIII.3
Functional layout test	Point sets, graphics, networks	BIII.1/2
Control information for video generator	Point sets (hardware-related)	BIV

Table 5. Overview of Applications of "Graphics" as Descriptive Tools in the Design Process

"Graphics" are syntactical tools which, depending upon application, differ in "semantic meaning" and "value".

Use of graphics for	Descriptive Tools for	Meaning of	
		Events	Edges
System design	Function	Global conditions or signal combinations	Transitional conditions, fulfillment of functions
	Structure	Components -- functional units	Connections -- signals
	
Logic design		Connections -- signals	Components -- functional units
	Function	Conditions -- signal combinations	Transitional conditions, fulfillment of Boolean expressions
	Structure	Connections -- signals	Components -- functional units
Electrical design	Function	Potentials -- signals	Component functions
	Structure	Connections -- event potentials	Components -- functional units
Layout design	Function	Potentials (electrical variables)	Phenomenological functions
	Structure	Geometrically defined point sets	Relationships between point sets

- Purpose- and task-related expansion of the terminal or EDP systems.

/Optimum organization of terminal application/ [in italics] is governed by the organizational principle and form.

Whereas the organizational principle is determined by the overall processing sequence (see Fig. 9, for example), the organizational form is determined by the type of application. The primary features of typical types of applications are:

- Centralized or decentralized terminal application
- Autonomous or non-autonomous configurations
(with on-line or off-line operation of a superordinate mainframe computer or a large data base or method base).

Aspects which determine the type of application and therefore the organizational form are the following effectiveness criteria:

- Frequency and time of use in terms of each application
- Overall workload at terminal
- Potential for functional integration of individual terminals or terminal groups.

Table 6. Primary Features in the Technological Development of the Design Process

1st Stage Characterized by:	2nd Stage Characterized by:	3rd Stage Characterized by:
- no technological examination of design process	- partial technological representation of design process	- thorough technological examination of design process
- construction of different individual models and representations for the design process	- partially formalized and unified models and representations	- unified models and representations
- heuristic, individual, intuitive design	- computer support by means of various island programs using differing computing techniques without interactive communication	- largely unified computer support using unified hardware and software
- no significant use of modern rationalization tools	- still no comprehensive use of modern rationalization tools	- use of alphanumeric and graphic displays for interactive communication and for largely machine-produced documentation
- primarily analytical method of operation	- primarily analytical method of operation	

Table 7. Significant Aspects of the Demands Placed on Design Engineers
(acceptance barriers)

New Subjects to be Learned	New Design-Related Skills to be Acquired	New Patterns of Thought to be Developed
- Circuit design techniques	- New kinds of structures	- Stronger formulation
- HL technologies	- with a high degree of integration	- More comprehensive symbology
- Design methods	- with new technical uses for electrophysical phenomena	- Abstract algorithms
- Tools and instruments	- with spatially and temporally distributed elements and parameters	- More comprehensive groups of functions
		- New functional representations
		- Logical, electrophysical and phenomenological equations as well as special geometric representations

Although optimum solutions to these or other groups of technical or technological problems can significantly lower the acceptance barriers, they cannot remove them entirely. In order to completely remove the acceptance barriers which result from the new requirements summarized in Table 7, these technical and technological solutions must be accompanied above all by comprehensive programs of qualification, training and continuing education; if possible, these programs should be systematically organized and carried out before the CAD system hardware is installed and the software implemented.

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 - H 5213-2002-1 E 0030 description of application
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Dr-Ing. Siegfried Pilz (53) trained as an installer of telecommunications equipment, studied telecommunications and control engineering from 1952 to 1958 at the Dresden Technical College. He then be-

came assistant to Prof Kindler at the Control Engineering Institute of what is now the Dresden Technical University. From 1960 to 1968 at the Dresden Institute for Control Engineering at the Academy of Sciences of the GDR, Dr Pilz was active in the field of digital controls. He received his doctorate in 1967 as a result of his "Contribution to the Calculation of Sequential Circuits." In 1968 he was appointed ordinary professor at the Ilmenau Technical College. He assumed the position of topic leader at the Center for Research and Technology of the VEB Robotron Combine, Dresden, beginning in 1977.

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GERMAN DEMOCRATIC REPUBLIC

APPLICATIONS, SPECIFICATIONS OF ROBOTRON CAD-CAM WORK STATIONS

East Berlin MESSEN STEUERN REGELN in German Vol 27 No 10, 1984 pp 446-449, 457

[Article by Prof Dr Herbert Willem, Engineer, and Dr Peter Kuntsche, Engineer]

[Text] 0. Introduction

Rationalization and the increasing degree of automation of product engineering and manufacturing processes are steadily becoming more and more significant international factors contributing toward a productive and flexible capital replacement process. The disproportionate annual growth in the use of CAD and CAM systems is expected to reach 30 to 40 percent by 1986 [1]. The use of such systems in a number of different fields such as electrical engineering and electronics, machine construction, the construction industry, plant engineering, automation, cartography and light industry will see average production increases of roughly 300 percent. Further performance increases, particularly in research, development and manufacturing, are predicated upon the provision and incorporation of communications and information processing technology into the automation of CAD and CAM sub-processes [2] and [3] as well as increasingly into the achievement of fully automated design, product engineering, manufacturing, planning and testing processes (CAE--Computer-Aided Engineering and DAUS--fully automated systems [4]).

Those characteristics of CAD/CAM systems which are the greatest contributors toward increasing the level of performance are:

- Reduction in the scope of development and transition processes for new and further-developed products while simultaneously maintaining the level and transparency of design and technological processes
- Improvement of product quality
- Flexibility in the product engineering phase
- Freedom from time-consuming routine tasks

Technically and economically effective use of CAD/CAM systems also requires simultaneous thorough preparation and introduction of such systems, which in turn includes conscientious planning and integration of further organizational processes and EDP measures to increase effectiveness, preparation of the required applications software as well as necessary training and continuing education and motivation of employees and management personnel [5].

The following groups of applications are under development by the Robotron Combine for different CAD/CAM tasks [6] through [9]:

- Drafting board-oriented design workstations (ROK A 5510) and digitizing workstations (DAP) based on the A 5120/5130 office computer
- Engineers' workstations (TAPL) based on the A 6402 commercial basic computer system
- Printed circuit board design workstation (AKT A 6452)
- Workstation for design and technology (AKT A 6454) based on the K 1630 microcomputer system and a peripheral graphics device
- Data acquisition and information system (DIS A 6422) based on a terminal-oriented basic computer system.

Following is a systems and application technology-oriented overview of the above-mentioned systems.

1. ROK A 5510 Drafting Board-Oriented Design Workstation

The ROK drafting board-oriented design workstation, which is based on the A 5120/5130 office computer, represents the applications solution for a DAP digitization workstation [10] and [11]. This applications solution represents a system which supports in the broadest sense the design process in the design, layout and dimensioning phases as well as in the preparation of documentation.

The DAP digitizing workstation unifies elements of a CAD system with the conventional methods of technical drawing. The workstation configuration combines a high-resolution HDG K 6401 or K 6402 digitizer (resolution: 0.01 mm; point-by-point and continuous digitization; size A2 and A0, respectively) with the office computer including the necessary software.

The digitized information can be intermediately stored on external data carriers or immediately output in the form of graphics. Graphical output uses the r 1157/269 serial printer with individually addressed needle control and the K 6418 flatbed plotter (smallest addressable step size: 0.1 mm; plot speed: max. 24 cm/s axially; plot size: A3) or the K 6411 (smallest addressable step size: 0.025 mm; plot speed: max. 60 cm/s axially; plot size: A2).

As a turnkey application solution, the ROK drafting board-oriented design workstation incorporates a separate digitizer and computerized processing equipment for finished drawings by means of simultaneous drawing and digitization. This system provides an effective and powerful foundation for the performance of a number of product engineering tasks, particularly in the fields of machine construction, the construction industry, cartography and the textile industry. This workstation, due to its favorable price/performance ratio, can also be considered not only as the initial system for small and medium-sized firms, but also a supplement to larger-sized CAD/CAM systems.

The ROK workstation incorporates the following basic functions:

- Digitizing function of the HDG software
- Merging of drawings which already exist on mechanically readable data carriers with the drawing to be digitized
- Structuring during digitizing; definition of digitized data as drawing elements and incorporation into drawing structures
- Possibility of entering a structured drawing from a mechanically readable data carrier for the purpose of modification
- Identification and manipulation (rotating, creating mirror images)
- Storage of drawing structures
- Editing of digitized graphical information for graphical output

The following rationalization measures can be implemented using this system, depending upon the task involved in each case [10]:

- The menu mask of the HDG offers the user 200 freely-selectable symbol fields. Using these fields, application-specific macros can be created, so that problem-oriented tools are available to each design office.
- The greatest benefits are achieved in cases in which standardized parts or symbolized representations predominate (such as in electrical engineering, hydraulics and architecture).
- Time-consuming writing in longhand is avoided through the input of numbers and letters via the menu field.
- Design tasks or drawings which concern repetitive parts are considerably simplified through the inclusion of complete individual parts, assemblies or entire units in the symbol fields.
- The percentage of errors is decreased and the informational content of the drawings is increased through the indication of time-consuming routine work. The capacity of the designer is simultaneously increased, and his creativity is motivated.
- Consistently high drawing quality of the design documents is ensured by the graphical output.
- The performance capability of the office computer allows complex numerical computations to be performed directly at the designer's workstation. In addition it is possible to use the office computer to solve problems outside the scope of the ROK by loading other programs.
- Existing drawings can be modified with minimal effort through graphical identification and manipulation.
- Through the capability to externally store data, new possibilities are created for the filing of data; in certain cases the filing of transparent originals can be completely eliminated.

The Robotron Combine possesses other CAD/CAM workstations based on the office computer in addition to its DAP and ROK workstations (a joint development together with the Karl-Marx-Stadt Technical College). Although details of these workstations are not described here, examples of their applications include:

- Handling of design tasks
- Acquisition, correction and printout of work schedule master cards

- NC programming and conversion/reconversion of data in off-line operation with access to mainframe computers.

2. TAPI Engineers' Workstation

A software package with the following subsystems is used for streamlining technological task sequences:

- Computer-aided operation and process elaboration, including the use of processors for processing flat parts to be drilled and for general technological tasks
- Technological information system including
 - implementation and modification of the technological database
 - re-use of technology for interactive terminal input of the search argument and representation of the work schedule master card
 - other research activities
- Acquisition and updating of technological master data
- Technological planning for new products using the "Technological Planning Project" and "Technological Coarse and Detailed Project" modules
- Mechanical programming of NC machines

These problem-oriented software systems (POS) have been developed by various enterprises within the Robotron Combine and the machine tool research center (FZW) of the "Fritz Heckert" Machine Tool Construction Combine, Karl-Marx-Stadt, and their marketability has been ensured, among other things, by

- Interface layout between general and user-specific program modules
- Use of user-specific files
- Provision of a solution method in conjunction with DBS/R database operating systems.

Expected quantifiable benefits are:

- Reduction of working time by 20-50 percent
- Reduction of primary costs by up to 50 percent
- Reduction of the transition times for new products by 20-30 percent

In terms of hardware, the TAPL workstation is based on an A 6402 (K 1630) commercial basic computer which can be connected to an EC 1040/1055/1055M master ESER computer.

3. AKT A 6452 Printed Circuit Board Design Workstation

The AKT A 6452, based on the A 6402 commercial basic computer system with graphical input/output peripheral device, is a procedure solution and comprises procedure specifications for manual processes and computer methods [12]. It takes over the complex processing of the various acquisition operations and checking, output operations and data protection in a largely automated fashion. This workstation enables the following:

- Better adaptability to the large number of degrees of freedom in printed circuit board design through interactive communication
- Decentralized processing of documentation
- Unification of printed circuit board manufacture

The RDG K 6403 raster digitizer (resolution: 2.5 mm (reduction ratio: 1:10), inductive scanning, size: A0) and the DZT 90 x 120/RS digitized plotting table (VEB Combine Carl Zeiss JENA) or the Digigraf 1208-3.5 G plotter (CSSR) are used as peripherals with the K 1630. If required, the r 1154 serial printer and the r 1215 carriage tape punch can also be connected to the control unit of the RDG; it is universally connectable to the K 1600 computer via the standardized IFSS interface.

The capability of the printed circuit board design workstation currently comprises primarily the systematized preparation of all document preparation. The initial document is a sorrel-colored draft, i.e. a drawing done by hand. The printed circuit board design workstation can be used to generate isolated as well as through-connection multilayer PC boards. A check of the board design is made to ensure that specifications have been met with regard to crossovers, trace paths, eyelet dimensions and distances between traces. The result is the final documentation, i.e. the generation of information on the data carriers which control the NC machines, plotters, photoplotters and automatic drilling machines. In addition, the plotter can be used to generate a top view of printed circuit boards with their full compliment of components when all such components have been catalogued.

4. AKT A 6454 Workstation for Design and Technology

The AKT A 6454 is an application-related, modular system which comprises the following equipment:

- KBR A 6402 commercial basic computer system (with arithmetic processor and 256 Kbyte main memory)
- Graphics peripherals
 - RSG K 8917 CRT terminal
 - high-resolution HDG K 6401 or K 6402 digitizer
 - DZT 90 x 120/RS digitized plotting table or
 - Digigraf 1208-3.5 G output device (EC 7907)
- Basic graphics and geometry software
 - GBS 1600 basic modular geometrical system (developed jointly by the Dresden Technical University, the Karl-Marx-Stadt Data Processing Center and the machine tool research center (FZW) of the "Fritz Heckert" Machine Tool Construction Combine, Karl-Marx-Stadt)
 - GKS 1600 graphical kernel system (developed jointly by the Rostock WPU and the Schwerin LfA)
 - graphics software for the DIG 1600 digitizer
- DVS 1600 data management system (developed by the machine tool research center (FZW) of the "Fritz Heckert" Machine Tool Construction Combine, Karl-Marx-Stadt)

The AKT A 6454 thus enables graphical input and output, graphical representation and the generation, manipulation and management of geometrical objects to which technological information is chained [13] and [14]. Working with the graphics peripherals (display, plotter and digitizer) is supported by the basic GKS 1600 and DIG 1600 graphics software.

The GKS 1600 program system for graphical input and output via the display and graphical output via the plotter supports the effort to arrive at a standardized graphics interface for user programs which is independent of the hardware used in each case (among other things through the concept of different coordinate systems).

The GKS 1600 is a close copy of the standard Graphical Kernel System, Version 7.0, as approved by the ISO. The following functions can be implemented using the GKS 1600:

- Two-dimensional graphical output to workstations including selection from available methods of representation (various different types of lines, line thicknesses, text formats, colors, etc.)
- Graphical input (also as a metafile)
- Image segmentation
- Creation of image windows and image transformation
- Transformation of image elements
- Storage of graphical information independent of the hardware (in the form of a metafile)

The DIG 1600 program system is available for working with the HDG K 6401 (K 6402). In addition to including this unit in the GKS 1600 as an input device, it is possible to generate a GKS metafile using the intelligence of the HDG (for further processing of digitized data). The digitizing process is supported by detailed prompts at the control unit. The following modes are available, and their selection depends upon the kind of task involved as well as the degree of precision required:

- Interval method
- Equal step size in both the x and y axes
- Constant step size in both the x and y axes
- Sequential digitization

The GBS 1600 basic modular geometrical system is used to generate, store, process and represent geometrical data. This interactive program system supports the work of the designer and the engineer in designing products, assemblies and parts, including the re-use of elements. The user-friendly design of the GBS 1600 allows easy entry, modification, manipulation, output and management of technological information utilizing largely interactive communication via the RSG CRT terminal. The basis for all manipulation of geometrical objects is the storage of the attendant data in an internal computer-oriented representation (RID). Compatibility with user programs is ensured by

- An interface to allow connection to the geometry processing module
- An interface (subprograms of the DVS 1600 data management system) which permits access by the user to the RID data.

The DVS 1600 data management system is used for the storage, management and reactivation of data. DVS 1600 routines are used to store large amounts of geometrical and non-geometrical data in virtual memory. These data yield an accurate enough description of specific assemblies and products, including their component parts. Modification, updating, etc. are also possible. In this manner factory standards can be incorporated into the processing by the GBS 1600 of standardized parts and semifinished products, and in the preparation of parts lists. The main applications for the AKT A 6454 are:

- Computer-aided preparation of drawings
- Computer-aided system and machine design
- Calculation of the parameters of individual parts
- Computer-aided programming of NC machines
- Computer-aided preparation of work schedule master cards

Use of the basic graphics and geometry software, in conjunction with user-specific software, enables the AKT A 6454 to be used for different design and technological tasks. Some initial such tasks are:

- Computer-aided chassis design (DKF 1600 - AUTENT; developed by the VEB Combine Passenger Cars, Karl-Marx-Stadt and the Dresden Technical University) [15]
The system is a special implementation of the AUTENT software package for the K 1600 and is used for designing double-curved surfaces, and in some instances also in the product engineering of these parts.
- Computer-aided product engineering in the shoe industry (DKF 1600 - GRAFIS; developed by the VEB Combine Shoes, Weissenfels) [16]
GRAFIS is used in the economical manufacture of forming, injection molding and casting tools with the aid of NC machines, as well as for automating the sewing processes using NC-controlled sewing machines. The system is used with a problem-oriented programming language of the same name. GRAFIS, as a fully automated system, can be used to advantage in other branches of industry such as in the manufacture of complex tools in the metalworking industry, forming tools for the foundation garment industry, to name just a few.
- Rotationally symmetrical parts (AUTOEVO-ROTA 1; developed by the machine tool research center (FZW) of the "Fritz Heckert" Machine Tool Construction Combine, Karl-Marx-Stadt; VEB Combines "Fritz Heckert", Karl-Marx-Stadt, and "7th of October", Berlin) [17]
This solution comprises the design and calculation of individual parts, assemblies and machines, as well as the preparation of manufacturing drawings for individual parts and technological manufacturing documentation for rotationally symmetrical parts.

5. DIS A 6422 Data Acquisition and Information System

The DIS A 6422 is available particularly for the acquisition and processing of operation and production data in the automation of discontinuous processes

[18]. This terminal-oriented, basic computer system, which can be adapted to the type of task to be performed by means of hardware and software, comprises a master system computer (K 1630) to which a maximum of 4 subsystems can be coupled via a K 8523 multiplexer. Additional intelligent terminals or controls such as the A 5100 office computer, the K 8931 universal display system and the A 5220 data collection system can be connected to the K 8523 by means of a maximum of 16 undedicated lines.

The configuration of a subsystem comprises a system control unit (SSE K 8524) with a standard memory sheet storage device and an r 1157 serial printer, as well as

- a maximum of 60 BDT K 8901 operation data terminals (representing the newest generation of operation data acquisition equipment developed by the VEB Robotron Combine), which are connected to the SSE via the IFLS-Z serial line interface (data transmission rate: 76.8 Kbit/s over a maximum of 3 km)
- a maximum of 8 DST K 8913 data stations which are coupled to the SSE via the IFSS standard interface (9.6 Kbit/s over a maximum of 500 m).

The SSE system control unit controls the IFLS-Z and the IFSS for the BDT and the DST. The SSE also links the system to the master computer, and stores the acquired data records as malfunction data in the event of a malfunction.

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- a) RSG K 8917 CRT terminal (developed jointly in cooperation with the Dresden Technical University)
 - K 7222 monitor (diagonal size: 310 mm; monochrome)
 - working area: approx. 210 x 100 mm²
 - alphanumeric mode with 1920 character display (representational format) of 24 lines x 80 columns; character set: 128 characters
 - graphic mode with 640 x 288 pixels (representational format) and scroll mode; screen refresh memory: 640 x 408 pixels

-

- b₁) High-resolution HDG K 6401 digitizer
 - maximum working area: 420 x 594 mm² (size: A2)
 - inductive principle of operation
 - maximum resolution: 0.01 mm
 - data transmission rate: max. 100 coordinate pairs per second
 - menu-driven or light pen/cursor command and data entry
 - operator prompts via BEA K 8911 input/output terminal or RSG K 8917 CRT terminal
 - point-by-point or continuous acquisition of measured values
- b₂) High-resolution HDG K 6402 digitizer
 - maximum working area: 841 x 1189 mm² (floor unit; size: A0)
 - maximum resolution: 0.01 mm
 - (this model is currently under development)

b₃) RDG K 6403 raster digitizer

- maximum working area: 780 x 1255 mm²
- inductive principle of operation
- resolution: 2.5 mm (additional reduction ratio of 1:10 is freely selectable)
- digitizer with functions selectable by menu, light pen or hand switch (installed on a REISS drafting board)

c₁) Digigraf 1208-3.5 G plotter (CSSR)

- working area: 841 x 1189 mm² (size: A0)
- resolution: 0.01 mm
- maximum drawing speed: 400 mm/s
- maximum acceleration: 0.3 g
- with 4 tools

c₂) DZT 90 x 120/RS digitized plotting table (VEB Combine Carl Zeiss JENA)

- working area: 900 x 1200 mm²
- resolution: 0.005 mm
- maximum drawing speed: 170 mm/s
- maximum acceleration: 0.12 g
- with 2 tools

c₃) K 6411 flatbed plotter

- working area: 420 x 594 mm² (size: A2)
- resolution: 0.025 mm
- maximum drawing speed: 600 mm/s axially (currently under development in cooperation with the Academy of Sciences of the GDR)

c₄) K 6418 flatbed plotter

- working area: 297 x 420 mm² (size: A3)
- resolution: 0.1 mm
- maximum drawing speed: 240 mm/s axially (currently under joint development together with the Academy of Sciences of the GDR)

The BDT operation data terminal is used for manually entering numerical data, automatic acquisition of machine data and for input of numerical data, using optically or magnetically coded data carriers (punched cards, punched identifying cards and magnetic cards are supported). Data is output via a 16-digit alphanumeric display and/or a thermal printer.

The CRT-oriented (16 x 64 characters) DST data stations are subdivided into a permanently defined command DST (command unit for subsystem-specific functions) and a maximum of 7 acquisition DSTs (acquisition, checking, processing and display of data records as well as interactive communication with a master computer, file printing station or text outputting station). The r 1152/252 or the 251 serial printer is used as the data output device. The following applications are eminently suited to processing by the DIS A 6422:

- Production surveillance and control systems
- Material and inventory control systems
- Time, arrival and absence control systems
- Information and evaluation systems
- Data collection systems

The DIS A 6422 data acquisition and information system and/or the A 5220 and A 5230 subsystems, in conjunction with additional complex equipment and terminals developed by the VEB Robotron Combine as well as free-programmable controls in the automation industry, form the basis of significant advances in the automation of our national economy.

6. Peripheral Graphics Devices for CAD/CAM Workstations

The peripheral graphics devices for CAD/CAM workstations in the VEB Robotron Combine described above are either already available or will be introduced in stages during 1984/85.

Summary

In the current five-year plan period, the VEB Robotron Combine continues to develop microelectronics-based CAD/CAM workstations together with its partners in technical colleges, academies and industry. The workstations illustrated in this article represent our own foundation for streamlining and increasingly automating product engineering and manufacturing processes, and are a further development of existing equipment (e.g. the KRS 4201 and the EC 1040/55/55M) to further strengthen the economy of the GDR.

At the present time, the broad use of CAD/CAM systems probably represents the greatest change in engineering methods. Computer-aided design in the individual technical disciplines requires a change in previous labor technology, if optimum use is to be made of all of the advantages of CAD systems. These changes can be summarized as follows:

- Working with CAD/CAM systems requires a high degree of systematization of the engineering work involved, as well as an analysis of design work with the objective of converting this work for use with computer programs.
- The use of CAD/CAM systems requires complete familiarization with modified and new tools on the part of the design office.
- The use of CAD/CAM systems offers new approaches to flexibility in the generation of manufacturing documentation, resulting in shorter throughput times and considerably more effective methods for introducing modifications.
- The effective use of CAD/CAM systems in design offices requires that a certain minimum number of personnel be responsible for continuous expansion and development of specialized design "tools."

In accordance with international trends, continued work on CAD/CAM workstations will involve the following areas of development in particular:

- Perfection of the performance of the computer base (as an autonomous workstation or computer system)

- Expansion of internal and external memory capacity
- Additions to the range of available hardware for graphical input and output (including interactive graphics terminals)
- Additions to the range of available basic graphics and geometry software (e.g. 3-D problem solving software)
- Expansion of the range of applications (e.g. placement and routing of traces in the design of printed circuit boards, inclusion of an image processing system in the design process and expansion of integration within the CAE process)

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Dr.-Ing. Herbert Willem (50) studied electrical machinery until 1955 at the Ilmenau Engineering School; in 1965 he completed a course by mail in the subject of control engineering at the Dresden Technical University. He has pursued scientific activities at the research center for the aviation industry, at the Central Institute for Automation and its successor, the Dresden Institute for Data Processing (most recently as technical director). He received his first doctoral degree at the Ilmenau Technical College. Beginning in 1977, he was the director of the Center for Research and Technology of the VEB Robotron Combine. In 1979 he was appointed honorary professor for process computer technology at the Dresden Technical University. His work concentrates on computer system development and the application of problem-oriented software for automation tasks. He is a member of the board of the WGMA.

Dr.-Ing. Peter Kuntsche (40) studied control engineering from 1966 to 1971 at the Dresden Technical University. He was then active in the fields of automation and computer technology. In 1977 he re-

ceived his first doctoral degree on the subject of problems of computerized process control. From 1978 to 1979 he was in charge of scheduling jobs dealing with automation in the VEB OBSAD, power plant equipment sector. From 1979 to 1983 he was topic leader for work on computer engineering systems, and beginning in 1983 he worked as a scientist for the plant director of the Center for Research and Technology of the VEB Robotron Combine. From 1977 to 1983 he lectured at the Dresden Technical University. In 1983 he became head of the technical committee "Computer Systems and Applications" of the WGMA.

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GERMAN DEMOCRATIC REPUBLIC

SOVIET INSTITUTE DIRECTOR ON GDR-USSR WELDING TECHNOLOGY

Magdeburg VOLKSSTIMME in German 29 Dec 84 p 4 supplement

[APN interview with Prof Boris Paton, Director, Electric Welding Institute (IES), Kiev]

[Text] The world renowned Electric Welding Institute (IES) was founded 50 years ago in Kiev. Its first director was academy member Yevgeni Paton, after whom the research institute was named. Since 1953 his son Prof Boris Paton, also a member of the academy, has been the director of the Kiev Electric Welding Institute of the Academy of Sciences of the USSR. He is also the president of the Ukrainian Academy of Sciences. APN spoke with Prof Paton about the work of the institute, held in high esteem both in the USSR and abroad, and about its partnership with the Central Institute for Welding Engineering of the GDR.

[Question] This is an anniversary year for your institute. What accomplishments would you and your colleagues like to recall on the occasion of this "birthday"?

[Answer] About 100 scientific and technical innovations of interest to experts in numerous branches of industry are developed at our institute each year. We develop hundreds of processes and welding devices which have proven useful not only for use on earth, but also under water and even in space.

[Question] Which of these accomplishments would you particularly like to emphasize?

[Answer] Electroslag welding, for example, developed in 1940. Standard electroslag welding is used only with metals, but it is the basis for numerous other processes: the electroslag remelting process for metals, electroslag cladding and electroslag casting, among others. The electroslag process guarantees a high degree of homogeneity in the metal which cannot even be achieved using the vacuum remelting process. Today we own more than 600 patents abroad which deal with the electroslag process.

[Question] You also mentioned the development of new welding devices. Can you give us some examples?

[Answer] Members of our institute developed welding transformers with very low short-circuit impedance, for example, as well as programmable devices; they also revolutionized traditional electroslag welding processes. Welding machines for rail and pipe stock based on this development have made thermit welding obsolete while guaranteeing high weld seam quality in which the characteristics of the weld are just as good as those of the base metal. In the U.S., Japan, France and other countries, the Soviet-made K-355 welding machine is used for welding rails together. It completes 10 welded seams per hour and ensures high joint strength.

The "Sewer" automatic pipe welding machine also operates according to the principle of programmable, automated welding, and can join pipes with diameters of up to 1440 mm.

The powder electrode wires for electric arc welding developed by our institute were a revolutionary innovation. Such electrodes were formerly used only for welding using the CO_2 shielded arc process; our powder electrode wire releases the shielding gas itself making the welding process substantially more economical. This is just an example of the kind of work we are doing.

[Question] Your institute is also renowned for having developed processes and equipment for welding under water and in space.

[Answer] Underwater welding became a new problem to be solved in conjunction with the mining of minerals on the ocean floor. The institute developed effective equipment for such applications. Our semi-automatic underwater welding equipment has increased the welding capacity of divers 25- to 30-fold.

For welding in space we had to take into account weightlessness, the nearly complete vacuum and the temperature gradient of from $+130^\circ$ to -150°C . It was necessary that the welding equipment be extremely reliable and safe to use. The devices developed by our institute meet these requirements. When cosmonaut Valery Kubasov first welded and cut steel, titanium and aluminum alloys in space in 1963 using our equipment, his achievement not only went down in the annals of space travel but also in the history of the science of welding.

[Question] For many years now you have cooperated with and been a personal friend of Prof Werner Gilde of Halle. What do you think have been the results of this relationship?

[Answer] Our institute has had close ties with the Central Institute for Welding Technology (ZIS) of the GDR since 1956. A very productive friendship also began at that time between myself and Prof Gilde, the head of the ZIS. In 1956 I first spent time in Halle and at the ZIS. During the following years our two institutions cooperated very actively. You could say that collectives have been formed which are in a position to solve current problems in the science and technology of welding. As an example we can name the jointly developed systems for electron beam welding, plasma arc cutting, equipment for welding plastics and numerous other new technologies which are used in industry in the USSR and the GDR.

[Question] What is the practical form of this cooperation between the two research facilities in Kiev and Halle?

[Answer] This cooperation is based on a number of different activities within the scope of the agreement between the CEMA nations concerning welding problems. Based on five-year plans and annual labor control, we are maintaining contacts in a number of different areas of current interest. The Institute for Welding Technology in Halle is the umbrella organization in two of these areas.

Extremely well received by specialists in the GDR and USSR are the jointly published catalogs of welding materials, cladding materials and welding equipment. For the first time it has been possible to provide a listing of all series-produced products in the CEMA nations with these catalogs which have appeared in the USSR and the GDR.

Such joint endeavors as seminars and summer school sessions devoted to single topics are also of great scientific and practical value. The course materials are published and are in great demand among experts. Following a coordinated program, there are also annual reciprocal consultation meetings among the specialists in our two countries which have had a very beneficial effect on the completion of planned activities on schedule.

[Question] What is the current central theme of your joint research efforts?

[Answer] First of all I would like to mention increased automation of welding processes and cooperation in the field of robotics. Our partners in Halle have achieved great success in terms of new developments in this area, as well as in the application of these results in practice. We can also claim accomplishments in this area. We have thus unified the knowledge we have gained and are involved in a joint effort to develop robots for electric arc welding. Also worthy of mention are our efforts to develop unique types of sensor systems for adaptive welding robots, to comprehensively equip whole industries with robots and to convert to flexible automatic systems in the fabrication of weldments.

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GERMAN DEMOCRATIC REPUBLIC

MATHEMATICAL ASPECT OF WELDING TECHNOLOGY RESEARCH DISCUSSED

East Berlin NEUE ZEIT in German 14 Jul 84 p 7

[Matthias Schlegel interview with Prof Dr Alexis Neumann, Engineer, Karl-Marx-Stadt College of Engineering]

[Text] [Question] Cooperation among the CEMA nations in the field of welding technology, your "specialty" as a scientist and educator, is a good tradition of long standing. How is this cooperation among experts from the socialist countries organized?

[Answer] As with all activities included within the scope of socialist economic integration, joint efforts in the field of welding technology are also directed from the Moscow seat of the Council for Economic Mutual Assistance. Technical coordination and organization are handled by the world-famous Paton Institute in Kiev; this coordination center forms the hub of all activities. In the GDR this management role is fulfilled by the Central Institute for Welding Technology (ZIS) in Halle, headed by Prof Werner Gilde.

The scientific and technical cooperation is divided into various topic areas. One key topic, for example, assigned consecutive number 9, is mathematics in welding, that area in which my efforts are concentrated in terms of scientific cooperation. From its beginning 12 years ago, I have been the head of this topic area which includes experts from six socialist countries.

Generally speaking, our activities involve establishing the computer-aided mathematical principles for practical applications of welding technology and thus the use of mathematical methods to investigate welding processes in order to optimize welding techniques.

[Question] In April of this year you headed the 12th CEMA Conference of Experts concerning the problems of welding technology which took place at the Warnemuende/Wustrow College of Marine Engineering. What did the experts discuss at this meeting?

[Answer] Since our joint research efforts are realized in terms of precisely defined five-year plans, we meet once each year to review our progress and to coordinate further activities. The week-long Warnemuende conference was one of these regular meetings which always provide an excellent opportunity to

exchange information and also to study the applications of our research efforts in actual practice. Since the current five-year plan concludes in 1985, we agreed at this conference upon the basic outline for our research efforts up to the year 1990.

[Question] Would you please give us some examples of scientific cooperation in your area of expertise in the past few years?

[Answer] Up to now about 20 concrete results have come out of the current five-year planning period. The participants at the Warnemuende conference of experts could see with their own eyes the great benefits of the practical application of these results during an excursion to the Stralsund shipyard. During welding of the many ribs required in the bodies of ships, unpredictable bowing of the ribs occurred as a result of the application of heat; this problem had to be subsequently corrected by means of a complicated straightening procedure. Using an additional heat source controlled by a computer to which measurement data is continuously input, these deviations can now be compensated as they occur. This solution, which will also be used in the future at the Warnow shipyard in Warnemuende, is based on a joint development of a collective comprising the Warnemuende/Wustrow College of Marine Engineering under the direction of Prof Beyer, and experts from the Paton Institute under the direction of Prof Machnenko.

For use in machine construction a software package for calculating the thermal processes involved in laser beam welding was developed with an annual savings of 100,000 rubles. The Baumann Technical College in Moscow took over the management of this project.

[Question] In addition to the example already mentioned, in what areas do GDR scientists participate to a significant degree in research?

[Answer] Checking the quality of welded seams is often a complicated and involved procedure. Such controls are of great importance, particularly in the case of joints subjected to very high loading. There are two possibilities: Either you inspect every seam--and this involves a great deal of time and money--or you make random checks--and this reduces reliability. Finding efficient processes using mathematical principles was a real challenge to our specialists.

Moscow scientists have worked out theoretical principles for mathematical and statistical models which are being compiled in the form of a specification by our colleagues at the ZIS in Halle and our own Karl-Marx-Stadt College of Engineering together with our Soviet partners. A mathematical and statistical quality control system for welded joints was developed which allows us in machine construction plants, for example, to make more precise predictions with fewer inspections.

Another series of topics is weldability, with which the Wilhelm Pieck University in Rostock has great experience. In welding it is well-known that heat treatments may be necessary before, during and after the joining process. Together with experts from the CSSR and the USSR, the people in Rostock have

developed a mathematical system which describes for each concrete case how much heat treatment is to be applied and where. This information has been compiled in a book, "TTT Curves in Welding" for which a publishing license has already been applied for in the FRG.

[Question] Union member Prof Neumann, you have been an engineer for more than 35 years now. As a bridge builder you once were intimately involved with statics, but then you came to the field of welding technology, and in particular its mathematical principles. For some time now you have been building bridges again--bridges of cooperation and friendship between scientists from the CEMA nations. Given the vast wealth of knowledge in the field of welding technology, is there still untouched, new territory to be conquered by international cooperative scientific efforts?

[Answer] First of all let me say that the real usefulness of cooperation lies in the fact that in pooling their research potential, both their intellectual and material scientific and technical resources, the various countries achieve a substantially higher degree of effectiveness in their research work. Co-operation works to such good advantage because, particularly in the case of mathematical models, the development of mathematical and statistical methods is very time consuming, very "labor intensive." Division of labor thus makes very good sense.

On the other hand--and this is probably what you are referring to--it is precisely mathematics, as a tool for solving welding problems in conjunction with immediate utilization of the values by computer, which offers unimagined potential. Therefore, producing software for researching welding processes and evaluating the loadability, the design and the making of welded joints as well as the optimization of all these processes will also be at the forefront of our investigations in the future. The development of automatic control systems for welding processes is also a broad field. This can be viewed as closely related to microelectronics as sensors, transducers and interfaces for automated welding systems must be developed.

The frequency with which mathematical models are used makes them worthwhile in any case, and socialist cooperation across national boundaries--and this brings us back to our initial topic--benefits us greatly.

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GERMAN DEMOCRATIC REPUBLIC

APPLICABILITY OF MODULAR VS UNIVERSAL ROBOTS DISCUSSED

East Berlin WOCHENPOST in German No 33, 17 Aug 84 p 17

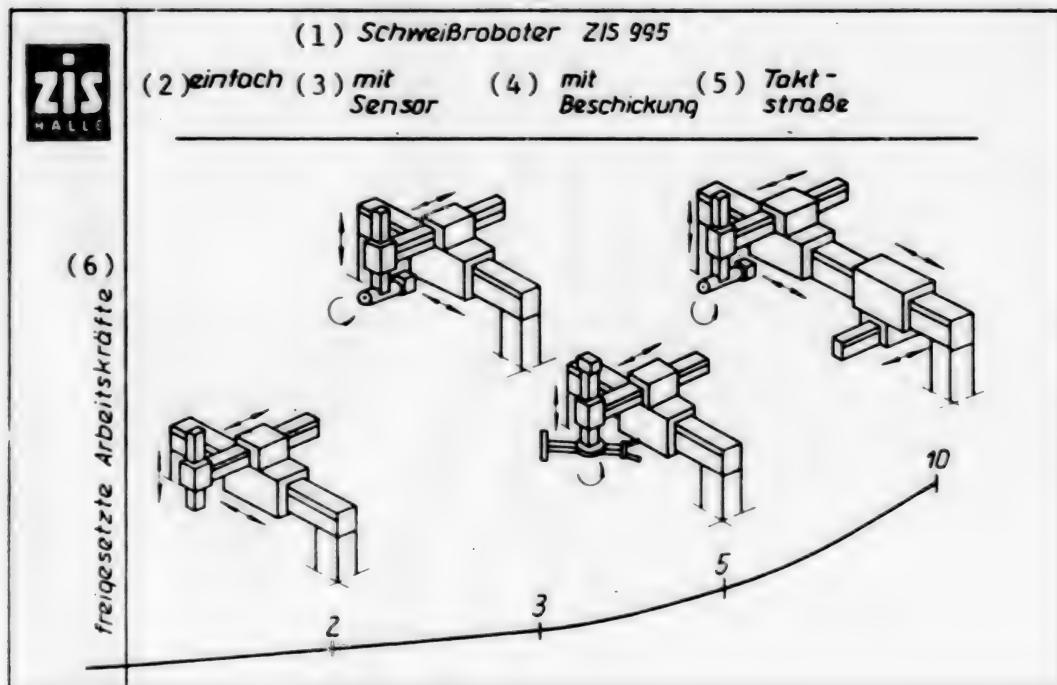
[WOCHENPOST interview with Siegfried Kiese, Engineer, Central Institute for Welding Technology (ZIS), Halle]

More and more robot manufacturers around the world are making the transition to modular assembly of their "mechanical men". The advantages of modular robots are enticing: With the modular system the user can assemble exactly the kind of robot he needs for a particular application. This kind of "tailoring" is based neither on ideals of beauty nor on fantasies found in utopian literature, but rather solely on economic and production engineering requirements. So often universal robots are used to perform tasks which could be accomplished using much simpler technology. Modular robots--used intelligently--prevent the advantages of new manipulating technology (high productivity and efficiency) from turning into disadvantages.

[Text] WOCHENPOST: When did ZIS modular welding robots come into being?

Siegfried Kiese: The idea of producing mechanized welding equipment made of standardized modular units already existed more than 20 years ago. At that time the purpose was to mechanize and automate welding processes. But to build a special machine for every single welding task was not feasible as a long-term solution. Thus the ZIS 650 system--in certain respects the precursor of our current modular robot--was developed in which welding machines could be assembled in modular fashion to perform a wide variety of tasks. Its advantage was flexibility, but its disadvantage was that these machines were not yet able to be equipped with the kind of controls commonly used in robotics today. Nevertheless, the ZIS 650 was a breakthrough.

Then around 1975 when the new manipulating technology became so successful and the first universal robots appeared on the market, the decision to use the modular principle with robots as well came to fruition at the ZIS in Halle. Because most of the welds performed in industry are simple longitudinal or circumferential welds, we decided upon robots based on a modular Cartesian coordinate system, i.e. with three axes at right angles to one another. With the modular ZIS 995 the user can construct a tailor-made machine with operating parameters geared to the given task. We call this adaptability of the



Key:

1. ZIS 995 Welding Robot	4. With Loading/Unloading
2. Simple Design	5. Synchronized Line
3. With Sensor	6. Workers Released for Other Jobs

robot to the welding task its external flexibility. It prevents robots from being used in a welding process at only, say, 10 or 20 percent efficiency. There are other advantages as well: savings in terms of design cost, inexpensive to produce, replacement parts are few and easy to keep track of. Our motto is therefore "not as much technology as possible, but rather as much as is necessary!"

Originally developed for resistance and electric arc welding, the ZIS 995 is also to be outfitted for other processes. Appropriate sample applications have been prepared such as for thermal cutting and soldering, for example. Our first soldering robot was on display at this year's spring trade fair in Leipzig.

WOCHEPOST: In your book "Roboter im Blickpunkt" [Focus on Robots] you define welding as a technological operation, and therefore you call welding robots technological robots--as opposed to loading/unloading and assembly robots. Can the latter also be assembled from modular units?

Siegfried Kiese: Of course. The machine tool construction industry, for example, has already made a loading/unloading robot based on the modular principle. Nevertheless there is a fundamental difference. The welding robot is

always at the same time a working machine while the loading/unloading robot is only a kind of assistant. Welding robots require the use of peripherals, i.e. a device at the workstation, to correctly position the workpiece for welding.

WOCHENPOST: The layman might assume that in the future all robots will be produced in modular form. But what conditions must exist in order to permit modular design?

Siegfried Kiese: There will always be special tasks where the modular system is not suitable. The modular principle can certainly not be seen as the only advantage in the design of manipulating equipment. It is a matter of providing a wide variety of devices for production automation with as few components and coupling points as possible. Occasionally, however, this also has the disadvantage that the modular system to be used for certain tasks also includes components which the user does not even need. In the final analysis, the modular system is a compromise. Modular robots should only be used in mass production, for example, when they can be fully integrated into the technology involved. If this is not the case, a special welding machine might be economically more feasible. We see examples of this in the automotive industry where large numbers of workpieces are processed by special machines and special robots.

WOCHENPOST: Is there a limit to the feasibility of the modular robot?

Siegfried Kiese: I would imagine that in the production of welded parts in quantities of up to 100,000 per year the use of special machines would be more reasonable. In practice, however, we deal with such a variety of different welded parts that it is not really possible to come up with a specific quantity as the limiting value for economic feasibility. In general, modular robots are suitable for any small to medium-sized series production run, however the technological task at hand is the decisive factor. That is why we always recommend that a study be made which contains precise statements concerning utilization of capacity before the robot is put into use. Only in this way can we get a clear picture of the most favorable robot features. In most cases the final decision would be to use a modular robot.

WOCHENPOST: How many individual parts are there in a ZIS modular robot? Is there an optimum figure for the number of modules?

Siegfried Kiese: The ZIS 995 has ten modules, but that need not be the optimum number. In the optical industry, for example, it may be higher. In our opinion a maximum of a dozen parts would be advisable for use in welding systems; if there are too many, the whole idea again becomes economically unfeasible. I would like to reiterate that the modular system is a compromise. The user must sometimes work with a two-meter axis when 1.5 meters would have been sufficient.

WOCHENPOST: Are controls and peripherals excluded from the modules?

Siegfried Kiese: Absolutely not! From the very beginning we have tried to include the control system. From a technical standpoint it is possible, although more difficult than in the case of mechanical parts. A special control module is even possible, consisting of a control unit for the actual welding process, for the sequence of movements made by the robot and--in the event that it is located in a production line--for the central control system, the task of which is to ensure that everything comes together at the interfaces. Regarding peripherals, a whole series of functional units would certainly be economically feasible, and would include turntables and swiveling tables. They must be able to be controlled by the robot so that additional peripheral controls are not necessary.

At present the ZIS is in the process of outfitting a modular robot for use in production lines. Robots with precisely as many axes of movement as necessary will be installed at the individual workstations. In an example of this kind of application which is currently under way--a production line for gas heaters--we are experimenting with robots with two or at most three axes. A universal six-axis robot would only be utilized at half its capacity. The modular system is particularly advantageous for use on production lines, because then welding robots would be linked to transport facilities and also to loading/unloading robots. Thus we can establish a certain degree of "teamwork" among robots.

WOCHENPOST: What problems have yet to be solved?

Siegfried Kiese: At present about 200 welding robots made of ZIS modules are in use in the GDR. Nearly all of them are still loaded and unloaded manually. This must change--the welder must be freed from this kind of monotonous work. Loading and unloading must therefore also be automated, i.e. removal from the magazine of the parts to be welded, placing them in position for welding and properly depositing the welded part.

Another problem we must solve is that robots must incorporate sensors in order to weld long seams. Without sensors, the robots continue welding in a straight line, ignoring tolerances which invariably occur with large and complicated workpieces. Although all ZIS robots can already be outfitted with sensors, in the future we want to offer a whole modular series of sensor types.

WOCHENPOST: How is cooperation with other CEMA nations progressing?

Siegfried Kiese: Experts are also working jointly on different areas of robotics at the CEMA coordinating center for welding technology at the Paton Institute in Kiev. A modular robot has already been produced in cooperation with the Paton Institute. Efforts are under way to achieve compatibility among similar developments in the CEMA nations and to standardize the modular units of individual welding robots.

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10 May 1985

GERMAN DEMOCRATIC REPUBLIC

NEW SENSOR FOR INDUSTRIAL METROLOGY DEVELOPED

Frankfurt-Oder NEUER TAG in German 5 Jan 85 p 2 supplement

[Text] With new developments in the field of industrial metrology, experts at the Technical College in Ilmenau have again contributed to upholding their international acclaim. These developments resulted from the fact that rapid advancement in scientific and technological fields is making processes and equipment of increasingly high precision necessary. After all, even a metal measurement standard is no longer a measurement standard if it is subjected to temperature fluctuations. In such cases, natural physical "parameters" such as the speed of light and fixed reference point temperatures have been considered reliable constants. One method of harnessing such natural norms for technical use and thus for exceptionally high-precision industrial metrological processes was followed by the experts in Ilmenau when they used the wavelength of laser light as the basis for a new kind of sensor.

The value of this development is currently being underscored by more than 20 registered proprietary rights within the GDR and over 60 such registrations by foreign industrial partners. This development makes it possible to input non-electrical variables such as travel, force, mass and pressure directly to a computer.

Dr Gerd Jaeger, head of the responsible process, measurement and sensor technology division of the technical and biomedical cybernetics section, describes the goal of research activity as follows: "In many cases comprehensive process automation requires that such variables be translated into computer language, i.e. digitized, with the highest possible precision." According to Dr Jaeger, international solutions are protected by comprehensive patents and are technically highly specialized, and this has led to the development of new ways of using light to "adapt" mechanical variables to electrical ones. This has been made possible by the fact that under certain conditions light--in this case laser light--propagates at a constant wavelength. These new optical interference sensors split the laser beam into two parts. The two laser beams are shifted with respect to one another as a function of the variable to be measured--i.e. as a result of the effects of such non-electrical factors--and then combined in such a manner that an interference pattern is generated in the form of alternating light and dark areas which can be measured by using

photodiodes to count the pulses. This sensor technology enables these signals to be processed in microcomputers which are built into the sensors.

The scientists found partners within industry in the Carl Zeiss Jena Combine and in the VEB Rapido Weighing Technology in the Nagema Combine. The scientists had recourse to modern Soviet findings, particularly with respect to the required technologies.

Initial applications illustrate the basic nature of this new technology: In the VEB Rapido Weighing Technology, production has begun on a new generation of scales which incorporate these sensors, whereby the technical college and the enterprise broke new international ground. The use of this principle in the development of a precision dilatometer has been viewed as a top international achievement. This device measures the changes in length of solid bodies as a function of temperature with a degree of precision never before achieved. According to Dr Jaeger, its precision is a power of ten higher than current international values.

The same also applies to travel sensors which measure displacement on the order of roughly one ten thousandth the thickness of a human hair. The development of these sensors as well as their application in precision measuring equipment--which simultaneously represented the beginning of a new field of scientific research at the technical college--have formed the basis, for example, of further development of methods of measurement at the Standardization, Measurement and Commodity Testing Office of the GDR.

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GERMAN DEMOCRATIC REPUBLIC

METAL FORMING COMBINE TO INCREASE CAD-CAM APPLICATION

Frankfurt-Oder NEUER TAG in German 4 Jan 85 p 3

[Article by Walter Florath: "Investments are no Warning Sign for us"]

[Text] 1985 has hardly begun, and already many employees are getting ready for next year--the first year of the next five-year plan. Parallel with the competition for continuing plan fulfillment, each day the requirements for high labor productivity and quality for the coming year are being met: Investments are being made.

Today, we are making investments in a different way than we did at the time of the first five-year plans. At that time it was particularly important that we expand our range of production, as Marx said. Today it is more important than ever that we make more effective use of our means of production, as he characterized the process of intensification.

For example, there is great demand on foreign markets for presses manufactured by our "Herbert Warnke" Metal Forming Combine, for new, higher-performance machines tailored to the specifications of our customers. But that is no reason to build new press factories. There are other ways to reduce the delivery time between receipt of orders and shipments of new machines from between 16 and 18 months to 8 months: the introduction of computer-aided workstations for engineers and technicians. 1500 such workstations are to be installed in our enterprises in 1985.

These workstations involve the Erfurt CAD/CAM system--computer-aided design and manufacturing. Use of such systems can reduce by 90 percent the time needed for manual calculation of assemblies and individual parts, with a 60 to 70 percent reduction in the amount of time needed to produce technical drawings. The productivity of design engineers and technicians--and this is the real issue--can be increased by up to 50 percent.

The law concerning the 1985 plan calls for "intensification of the modernization and streamlining of entire areas of production through increased use of microelectronics, measurement and control, and robotics."

This does not mean that new equipment and complete production systems must be installed everywhere to replace existing ones. The law concerning the

five-year plan for the period 1981 to 1985 had already emphasized the importance of "modernization of the continuously growing stocks of basic resources." This we have done successfully. In the plan for 1985 we have established the fact that "the effectiveness of basic assets" is to be increased through socialist rationalization together with better use, modernization and capital replacement of that which is available. Modernization must become the primary method of capital replacement."

Erich Honecker stated at the start of the new year that our economic growth in 1984 was brought about with hardly any increase in the size of the work force, and this was due not least of all to our policy of investment, a policy which promotes intensification.

We intend to continue on this course. Based on a new thrust in rationalization, we intend to achieve the required increase in labor productivity, because we also want to reduce the number of jobs in the future. We have no unemployment; we can only achieve increased production of consumer goods, increased production of our own raw materials, better utilization of our basic assets, increased production of rationalization equipment and industrial exports if we decrease the total number of hours worked this year by 493 million through scientific and technical means.

The Schwedt Initiative continues to be an example for all enterprises in our country of how effectiveness can be increased without hurting the workers, but rather together with them, and for their benefit. The Schwedt Initiative--that is the socialist answer to capitalist rationalization.

There was much speculation in capitalist countries at the end of last year about what course the economy would take in 1985. In the FRG the government was unhappy with the prognosis of research institutes, probably a realistic one, which stated that economic growth would reach two percent at best. Eager-to-please scientists, the so-called five wise men, quickly put together a prognosis which included higher growth figures. Since then the capitalist press has been wrestling with the question of whether growth of two or three percent is to be expected in 1985. It is the opinion of the optimists that exports to the U.S. will give the economy a needed boost, while the pessimists, or realists, are predicting "declining foreign trade figures," as the Duesseldorf HANDELSBLATT reported in mid-December. Economists and politicians also expect increased investment activity to bring about an improvement, if only slight, in the economy.

But even if 1985 saw a "wave of investments", as the HANDELSBLATT put it, the Metalworkers Union (IG Metall) within the West German Labor Union Federation (DGB) has stated that "no new jobs could be expected". At the beginning of the electronic age, said the union chairman, the "wave of investments has given more cause for fear than for hope ... It could today initiate the technology and rationalization thrust which has already been seen for a long time as writing on the wall."

And this is where research institutes and experts in all fields are of the same opinion: The new year will not bring about any reduction in mass

unemployment. On the contrary: The number of chronically unemployed--those who have not found work for more than one year and who therefore have stopped receiving unemployment benefits--will continue to increase. This is the source of the new poverty which the DGB has found in the Federal Republic of Germany.

What Erich Honecker referred to in September of last year in the EINHEIT has been confirmed once again: The material power of capitalist countries must not be underestimated, however it is plain to see that that system, even with the most sophisticated means of production, cannot come to grips with the problems of the working class."

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MACHINE TOOL MODERNIZATION EFFORT SAID LACKING UNIFORM SUPPORT

Magdeburg VOLKSSTIMME in German 11 Dec 84 p 3

[Article by Rainer Lampe]

[Text] In the diesel engine production section of the Karl-Liebknecht Plant in Magdeburg, a dexterous robot operates a lathe. The robot feeds the work-pieces, removes the finished parts and places them on pallets. This type of activity has become almost commonplace; in our country 35,000 industrial robots are employed, around 2500 of them in our Bezirk alone. However there is something unusual about this special robot in the Karl-Liebknecht Plant. Actually, it's not the robot itself which is unusual, but rather the way in which it is coupled to the old turret lathe.

The usual case has always been to couple robots to new, electronically controlled machine tools. This is the simplest way, and it has proven beneficial. But we cannot install modern machinery everywhere; that would not only be much too expensive, but in many cases it would not even be necessary. In cases where new machines are not necessary, there is another, more cost-effective way of solving the problem. When older machines undergo general repair, the occasion is also used to completely modernize them. The machines are converted, fitted with modern controls and made ready for operation by robots.

It Costs Less but Brings Results

This procedure costs far less than the purchase of new machines, and the benefits are great: Three workers are released for reassignment, and the investment pays for itself in just 15 months. Because intentions are to later couple a second turret lathe to this robot, the economic benefit becomes much greater.

Thus this procedure, used for the first time in the GDR, is of interest to many enterprises. The Oschersleben pump factory has already implemented this solution. The necessary documentation was supplied by the Bezirk Industrial Robotics Science and Production Cooperative. Under the direction of the VEB Research, Development and Rationalization of the Heavy Machine and Plant Construction Combine (FER) the cooperative comprises 20 combines, enterprises and scientific facilities such as the Otto von Guericke Technical College. Their common goal: mutual assistance and support to anyone planning to use robots, whether a member or not.

In helping to establish the use of 2500 industrial robots, the cooperative has also been responsible for making Erich Honecker's words at 9th SED Congress a reality for our Bezirk as well: "In accordance with the state of our economy, increasing productivity is more and more becoming a result of scientific and technical advancement, above all in the implementation of modern production technologies."

What an Invoice Shows

But even in view of this evaluation, we must look at the current situation with a critical eye: One of the goals which our Bezirk must meet is the employment of 4500 industrial robots during the current five-year planning period, thus adding at least 11,250 workers to the labor pool, above all for expansion of shift work on the modernized production lines. Even a cursory comparison of figures shows what is expected from our Bezirk by the time the XI SED Party Congress convenes.

During a seminar held recently in Magdeburg by the FER and the Bezirk Planning Commission, to which representatives of the councils and regional cooperatives in the Kreise were invited, discussions were also held concerning the causes for the delay in the implementation of robots: Experiences gained in the use of robots are not being made as available as they should be and far too little use is being made of them--although each robot use must be reported to a data base in Karl-Marx-Stadt, only 2000 such reports from throughout the Republic have been received. Although this data base should be consulted before each robot use so that "the bicycle is not reinvented each time," only 1600 applications for information have been made.

Similar experiences have been reported by our Bezirk "data base"--the Bezirk Industrial Robotics Science and Production Cooperative. In general, this means that the use of robots is being pursued half-heartedly in many enterprises, and is therefore costing too much in terms of money and expertise. "Probably every one of us has paid an apprenticeship premium, but must we all really pay the same money again?", asked a representative of the "Karl Liebknecht" Heavy Machine Construction Plant in Magdeburg at the above-mentioned seminar. Indeed, with all that has been learned about robots in the meantime, we should be quite a bit nearer our goal of 4500 robot applications.

Only if We Want To

We know, for example, how all requirements for the use of robots can be met even in smaller enterprises such as Roland Outerwear in Calbe, Galvano in Schoenebeck and many more. We know--for example through cooperation between the VEB Machine Construction and the VEB Abrasives in Stendal--how effective regional cooperative work can be, assuming the desire for such work exists, which is not the case everywhere.

This alone indicates that the way toward a significant increase in the number of industrial robots and toward further increasing their economic benefits requires the same desire and expertise everywhere in the Bezirk.

In the Magdeburg science and technology center of the heavy machine and plant construction section, experiments are being run using a new robot outfitted with sensors. The optical sensors for detection of the top edge of workpieces enable the changeover time of the robot to be shortened from 30 minutes to 30 seconds. The VEB FER collects and makes available experiences with robots throughout the Bezirk.

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NEW MARKETS FOR NC, CNC MACHINE TOOLS

Budapest NEPSZABADSAG in Hungarian 12 Apr 85 p 4

/Text/ SZIM, the Machine Tool Industry Works has found new foreign markets for its products. In 1984, SZIM sold a few, modern NC and CNC installations to India; this year shipments will increase, and cooperation agreements have been concluded with the Indian partners for the joint manufacture of various parts and components. China is a new market for SZIM. Several modern, high-performance machining production lines will be exported there this year.

Nowadays, SZIM produces NC and CNC system machines virtually exclusively. Only 100 of the less valuable machine tools which were formerly traditional will be manufactured this year on order from abroad. These latter account for a mere five-six percent of total SZIM production.

CSO: 2502/42

DETAILS ON COMPUTER HARDWARE FROM POLONIA FIRMS

AC 805 Personal Computer

Warsaw INFORMATYKA in Polish No 11, Nov 84 pp 14-15

[Article by Ryszard Stefanowski, Ameprod: "Personal Computer AC 805"]

[Text] As has been promised, we print here a description of the new microcomputer produced in Poland. Compared to the ZX81, this is a design of a higher class. Unfortunately, it is much more expensive. Ameprod has estimated that it could bring its production capacity up to 300 such units annually. It can easily be projected that that would be a drop in the bucket of the demand, especially since there are rumors that Polish Railroads wants to place an order for ... a thousand units. In Western nations, a large order is the big chance for the manufacturer, but in Poland that could mean ... a disappearance of the company from the market for several years. The future will show if Ameprod will be able to reconcile its ambitions for spreading microelectronic equipment in Poland with the "offers that cannot be refused."

The experience that has accumulated over the two years that personal computer ZX81 has been manufactured and sold prompted Ameprod Polonia Company to develop its own computer system. The model AC 805 described here was first shown at the International Fair in Poznan in 1984. It is the basic version of the series AC 800, which also includes models AC 815 and AC 825.

Housed in a compact, streamlined and elegant case, the system includes a CPU panel, the keyboard panel and the power source providing the necessary power supply. The central unit is an 8-bit microprocessor Z80. The minimum computer configuration comprises the AC 805, screen monitor or a television set (used as a screen monitor) and a cassette recorder (external memory). The AC 805 is equipped with a Mikro System, an interpreter of Basic language (compatible with Microsoft standard, similar to the version used in the Nascom computer) and a screen editor. The above-mentioned systemic software is kept in the permanent ROM memory of a capacity of 12 kB. Three versions of dynamic RAM memory with capacities of 16, 32 or 48 kB are provided.

Preparing the AC 805 for operation is simple: the unit is connected to the monitor and the tape recorder and plugged into a power outlet. When the unit is turned on, the Mikro System is called. The user has a choice of 19 instructions, allowing:

- input to a Basic interpreter ("cold");
- input to Basic interpreter ("hot");
- change of input and output configurations;
- initiation of implementation of the program in machine code;
- program entry and readout with the use of the cassette recorder;
- change of the transmission speed of serial ports;
- setting the interrupt point for the program being executed;
- control and callout of the contents of individual memory locations and registers.

The AC 805 has been designed as a personal computer for professional applications and can be effectively used for training purposes or for computer-assisted design. In view of this, special attention was given to communication between the computer and the external devices. The AC 805 has two serial ports (standard RS 232 C), AUX and HOST, with the nominal transmission speed of 150-4800 and a 24-bit programmable parallel port. The serial transmission can occur without participation of the central unit, allowing the possibility for connecting two AC 805 computers and conducting simultaneous transmission between the computer and the external device connected to the serial port. The parallel port allows connecting to the system nonstandard peripheral devices, for example, registration units, controllers, printers or plotters operating through parallel connection.

The keyboard of the QWERTY type has a rubber pad and a plastic cover. The pad has a mechanical hysteresis, providing the user with a nonambiguous information as to the pressing of the keys. Special function keys (for instance, CLEAR, HOME) are helpful with writing and editing of programs. The use of the monitor occurs through the video output or UHF modulator, operating on 36 channels. The screen monitor service unit controls 24 lines of 32 characters each, operating on the basis of an image memory (video-RAM). This video memory has an address system to that of the microcomputer.

The microcomputer has two symbol generators. The basic generator has the complete set of ASCII characters, with upper and lower case, and under 100 graphic symbols. It resides in the ROM memory. An additional generator allows defining 128 symbols by the user. This provides a pseudographic capability throughout the image area and permits the user to create nonstandard alphabetic face types or alternative alphabets (for instance, Cyrillic). Access to the video memory is not synchronized with the light extinction signals.¹

Table 1. Specifications for the AC 805 Microcomputer

Central unit: Z80

Programming:

- Interpreter of Basic language according to Microsoft standard (9 kB)
- Monitor, type Mikro System
- Optional operations system compatible with CP/M 2.2

ROM memory, 12 kB

RAM memory, 16, 32 or 48 kB

Mass memory:

- Standard cassette recorder (modulation FSK 300 or 1,200 baud)
- Optional 5.25-inch floppy disks, 1 MB

Display screen capability: 24 32-character lines, 96 ASCII symbols, 32 graphic symbols, 128 programmable characters, pseudographics capability

Connections: serial 2 x RS 232C, 150 to 4,800 baud; parallel 24 lines TTL

Keyboard: QWERTY, rubber pad, plastic keys

Computation accuracy: 7 digits

Price: basic model, 400,000 zlotys (Aug 1984)

Manufacturer: Ameprod, Poznan

Order-filling time: depending on the number of orders, production volume in 1985 approximately 300 units.

Emphasizing the educational value of the system, we should mention the possibility of implementing programs (under the control of the Mikro System) to be entered in a machine code, as well as the editing of these programs and their joint operation with programs in the Basic language.

The writing and running of Basic programs is facilitated by the screen editor with the cursor moving on the screen in all directions and allowing the possibility for deleting or inserting a line or changing the contents of a line in the program.

A feature of the AC 805 is the possibility for preparing machine code programs for the laboratory unit ZLA 01,² owing to the use of the same standard of records on magnetic tape and in the two devices (FSK modulation). This feature expands the educational value of the AC 805 as a tool for practical laboratory work in learning microprocessor technology.

The computer is a basic version of the AC 8005 family. For 1985, the version AC 825 is planned, which will work with the Winchester AC 925 WD disks. Work is also continuing toward the production of AC 815 version, which will use 5.25-inch floppy disk stations, AC 815 FDD.

The external memories will use drives manufactured by BASF and will be controlled by the operation system compatible with CP/M 2.2. In the 815 version, the user will have access to a total of 1 MB memory (two disks with recording on two sides). For model 825, Winchester 10 and 30 MB disks will be used.

Table 2.

Program no.	Execution time
1	1.99
2	7.44
3	18.00
4	18.50
5	19.75
6	30.35
7	43.75
Total	139.78

Tests of the AC 805 system have been published in the third issue of this year's INFORMATYKA (after PPC Computer Journal, Vol 1, No 10, p 10, 1982). The above table gives the time of execution of individual problems: the total indicates that the AC 805 has an operational speed comparable to that of units of the same class existing the world.

IMZ-80 Microcomputer

Warsaw INFORMATYKA in Polish No 12, Dec 84 pp 14-15

[Article by Wieslaw Kaska, Impol II Company: "Microcomputer IMZ-80"]

[Text] In this article, we present a new Polish-made microcomputer. The design is special: one has the impression that the IMZ-80 is devised as a system for use with a common type of memory--floppy disks (limited resident program). The possibility of using a cassette recorder is evidence of a realistic attitude on the part of the manufacturer: it does not offer options that are unlikely to be utilized. This is a design which takes into account what is available on the domestic market and the limitations of the manufacturing of Polish peripheral devices. This offering by Impol will certainly be of use to whoever owns "inputs" and can obtain disk drives. There is no need, then, to waste money on unnecessary resident programs. Those who have no disks, however, can enter into the additional EPROM memory the program that is used most frequently and thus facilitate the operation.

The IMZ-80 microcomputer is constructed with the use of the Z80 microprocessor and large-scale integrated circuits. It is intended for use in education, office automation, scientific and technical research, as well as for electronic games.

The basic model has a working memory of 64 kB (4 kB occupied by the video memory and the working area of the keyboard), QWERTY keyboard, interface with cassette recorder, system controlling the screen monitor and an adapter for connecting the computer to the antenna input of the television set. The IMZ-80 also has a clock and a generator of acoustic signals.

The programming for the basic version comprises Loader placed in permanent memory (the so-called Shadow ROM), as well as Monitor, Basic and Macroassembler, which are read out from the cassette tape. The Macroassembler comprises Editor, Compiler and Debugger for programs written in the Assembler language of the Z80.

For building up the microcomputer configuration, a so-called expander is used. This is a module that buffers the signals from microprocessor trunk and allows placing up to six additional modules into a built-in cassette. The list of modules offered by the manufacturer (or to be offered soon) includes interface with the DZM 180 printer, interface with the PK8 cassette memory, a module of permanent memory EPROM (16 kB), the programmer of EPROM memory for types 2716 and 2732, serial communication contactor V24 and circuit for connection to 5.25" and 8" floppy disk drives. The drives for the 8" are Plx45D (manufactured by Mera-KFAP); for the 5.25" disks K5600.10 (by Robotron, GDR) can be used.

The availability of disk memory or floppy minidisk memory makes the IMZ-80 an equipment that could be used for professional applications. It accepts a broad list of existing software, in particular that of the operation system IMPS (the functional counterpart of the CP/M system), interpreter of Basic language (MBASIC) and language compilers for Basic 80, Fortran 80, Pascal/M, macroassemblers, etc.

The main input/output devices are keyboard and screen monitor. The keyboard has separate alphanumeric and functional fields, including a key for control of the movement of the cursor. The user may find some difficulty in mastering the double function of the key for cursor control: the same key, when used without SHIFT, moves the cursor to the right, and when the SHIFT is on it moves the cursor to the left.

Up to 25 lines of 40 characters each can be displayed on the screen. Either a monitor (such as Neptun 156 by Unimor) or a standard television set can be used for this purpose. The character set consists of 96 characters ASCII and 64 semigraphic symbols.

The microcomputer with additional modules in the internal cassette is powered by a built-in pulse source of high reliability, allowing long operation without internal and external ventilation. The external modules (such as the disk memory) require an external power source, which is just a slight inconvenience that should not detract from the quality of the microcomputer. The definite advantage of the IMZ is its light weight.

Table 1. Specifications for the IMZ-80

CPU: Z80 (ZILOG)
RAM: 64 kB (including 4 kB video memory)
Tape recorder connection
Clock
Television antenna input control
Sound generator
Programming:

- EPROM, 16 kB
- connection to DZM 180 printer
- connection to cassette memory PK3
- V24 connection
- connection to floppy disks and minidisks and IMPS operations system
- EPROM programmer

Price of main version: around 480,000 zlotys
Order-filling time: about six months
Manufacturer: Impol II Polonia Enterprise, Warsaw

The first copies of the IMZ-80 are passing their early "combat trial" at ZETO Olsztyn, the Laryngology Clinic of the Medical Academy at Lublin, the Institute of Meteorology and Water Management and at a number of other research institutes. Users write their own application programs that suit

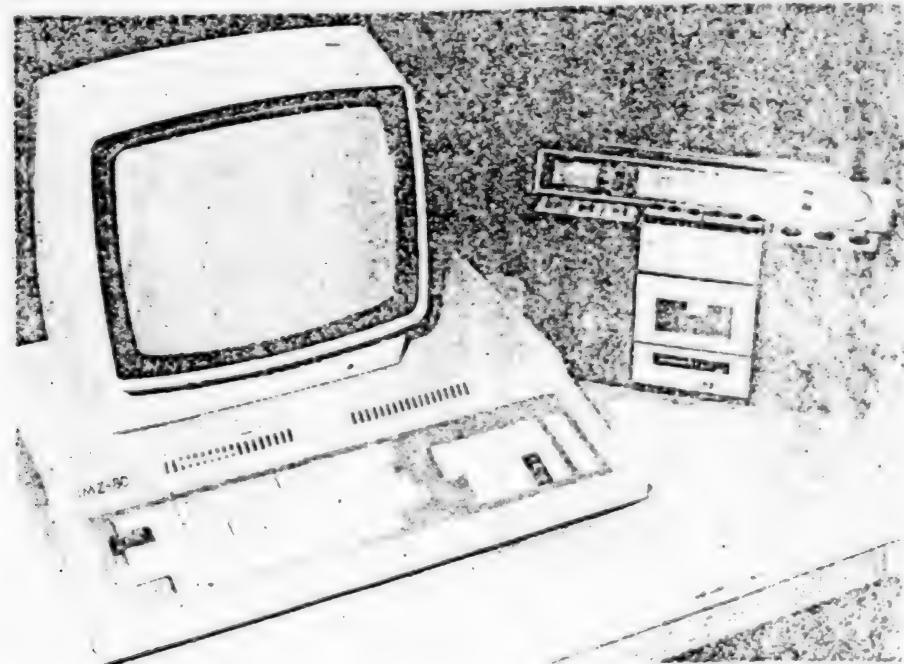


Figure 1.

their specific needs. Most applications are engineering and scientific calculations, including the collection and processing of statistical data.

The test programs proposed in Mikrolklan 3/84 are operated by the IMZ-80 with the following results: 1 (approximately 1 s), 2 (approx. 8 s), 3 (approx. 15 s), 4 (approx. 22 s), 5 (approx. 24 s), 6 (approx. 35 s) and 7 (approx. 52 s).

The total time is approximately 157 seconds. These measurements were done with a stopwatch.

FOOTNOTES

1. As a result, the blinking of the image can occur when a large part of the information kept in the video memory is called. However, except for a small number of specific programs, the user does not normally have to deal with this problem (AJP).
2. The laboratory unit ZLA 01 is a one-panel microcomputer built around the INTEL 8080 (MCY 7880) processor, manufactured by Ameprod Polonia Enterprise (author's note).

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NEW DESIGNS FROM ELECTRONICS R&D CENTER

Hybrid Microelectronic A/D, D/A Circuitry

Warsaw POMIARY AUTOMATYKA KONTROLA in Polish No 12, Dec 84 pp 375-377

[Article by Wladyslaw Wielich, an engineer of Mera-Obreus Electronics Factory: "An Assembly of Hybrid Microelectronic Circuits for A/D and D/A Conversion"]

[Text] The Research and Development Center for Specialized Electronic Systems at Mera-Obreus in Poland has developed hybrid microelectronic circuits to be used in computer-object interface devices.

These circuits are based on the technology of thin silicon films and micro-assemblies of printed circuits.

D/A Converter Type HPAC-12

The unit converts binary 12-bit TTL code into current and with the aid of an internal converter system also into voltage.

A block diagram of the converter is shown in Fig. 1. The converter consists of three identical four-bit units for current sources with outputs in a proportion of 1:2:4:8 and analog switches I_A , I_B , and I_C .

Unit I_A contains an additional compensating source I_p connected with the other sources. All current sources are controlled by the amplifier W_p in such a way that the current from source I_p produces on the resistor R_5 a voltage equal to the reference voltage U_0 . The regulation circuit K_w enters additional current into the resistor R_5 to change the output of all current sources. The current from the sources of the individual units is conducted to the current output (output 6) through current dividers: for unit I_C , the ratio is 256 (resistors R_2 and R_3); for unit I_B , the ratio is 16 (resistors R_1 and R_4) and for unit I_A the full output.

The reference current is taken at the output of amplifier W_0 connected to the bridge unit with reference diode D_r . By connection between the output of the amplifier W_0 and the current output of resistor R_6 , the flow of additional current in the direction opposite to that of sources is created,

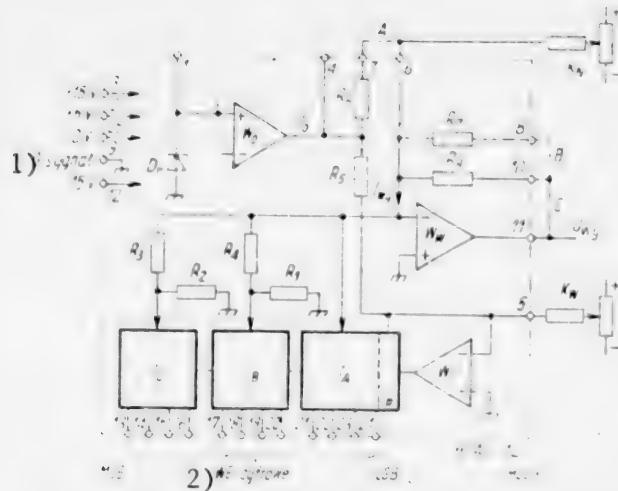


Figure 1. Block-diagram of D/A converter, type HPAC-12.

Key:

- 1 - 0 signal
- 2 - Digital input

approximately equal to the value of the current of the highest bit (when the voltage at output 6 is 0 V). As a result, a bipolar output current is obtained. By means of the regulating circuit K_N , it is possible to adjust the value of this additional current, and also for the unipolar output correct the imbalance of the amplifier W_W . The amplifier W_W converts the current into voltage (coupled with resistors R_7 and R_8). It is possible also to use an external operational amplifier with better parameters than the built-in amplifier of HPAC-12. In this way, a more rapid conversion could be obtained. Table 1 gives the methods of connection for the various conversion ranges. The parameters of the HPAC-12 unit are given in Table 2.

Table 1. Methods of Connection of HPAC-12 Converter (Fig. 1)

<u>Output</u>	<u>Connections</u>		
	<u>A</u>	<u>B</u>	<u>C</u>
Current			
Unipolar	0	0	0
Biopolar	1	0	0
Voltage			
Unipolar 10 V	0	1	1
Bipolar 10 V	1	1	1
Bipolar 20 V	1	0	1

0 - off; 1 - on.

Table 2. Basic Parameters of D/A Converters

Parameter	HPAC-2	DPACA-10
Characteristic of digital inputs	TTL	TTL
Resolution in bits	12	10
Range of voltages converted, V	0 - 10, -5 - 5, -10 - 10	0 - 10, -5 - 5, -10 - 10
Range of current converted, mV	0 - 10, -5 - 5	0 - 10, -5 - 5
Nonlinearity error	$\pm \frac{1}{2}$ LSB	$\pm \frac{1}{2}$ LSB
Current stabilization time, ns	300	250
Voltage stabilization time, μ s	60 (5 μ s)*	60 (3 μ s)*
Operation temperature range, °C	0 - 70	0 - 70

*Parameters for external amplifiers, Ww, e.g., μ A 715 or LM 118.

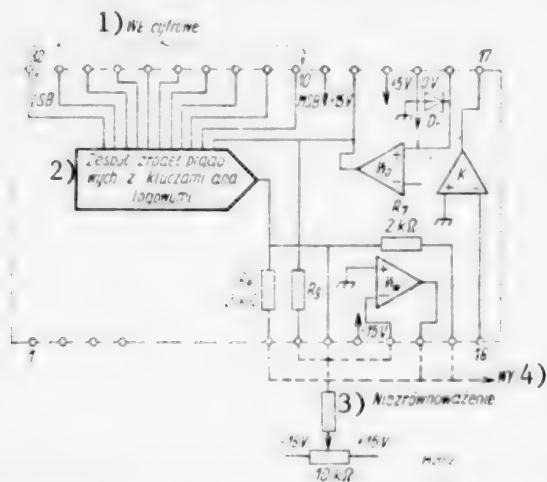


Figure 2. Block-diagram of D/A converter, type DPACA-10.

Key:

1. Digital input
2. Set of current sources with analog keys
3. Disbalance
4. Output

D/A Converter Type DPACA-10

The DPACA-10 converter is based on the same concepts as the HPAC-12. It differs from the latter by the absence of two lowest current sources (system resolution is 10 bits), but it is equipped with a comparator device

that is adapted to the D/A converter, facilitating the implementation of A/D circuits. The block diagram of the device is given in Fig. 2 and the electrical parameters in Table 2. Figure 3 gives the block diagram of the A/D converter used in conjunction with the DPACA-10. The base parameters of this system are given in Table 3.

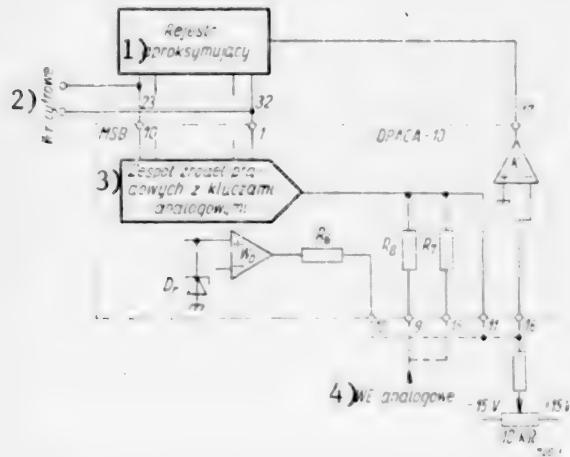


Figure 3. D/A converter with DPACA-10 circuit.

Key:

1. Approximation register
2. Digital output
3. Set of current sources with analog keys
4. Analog output

Table 3. Basic Parameters of A/D Converters

<u>Parameter</u>	<u>HPAC-12</u>	<u>DOACA-10</u>
Input voltage range, V	0 - 10, -5 - 5, -10 - 10	0 - 10, -5 - 5 -10 - 10
Resolution in bits	12	19
Nonlinearity error	$\pm \frac{1}{2}$ LSB	$\pm \frac{1}{2}$ LSB
Conversion time, μ s	10	7 - 8
Operation temperature range, °C	0 - 70	0 - 70

A/D Converter Type HPAC-12

The unit is a source for fast conversion of current into 12-bit binary TTL code. It operates according to the approximation principle and utilizes D/A converter, approximation register and comparator. The block diagram is given

in Fig. 4. The basic parameters are described in Table 3. The converter is offered in two models: in one, marked HPAC-12, a D/A digital current converter is used (which is identical to that in HPAC-12), as well as a comparator K. The other model, marked RA-12, has an approximation register. The register RA-12 is a hybrid system. A monolithic register could be used instead of it.

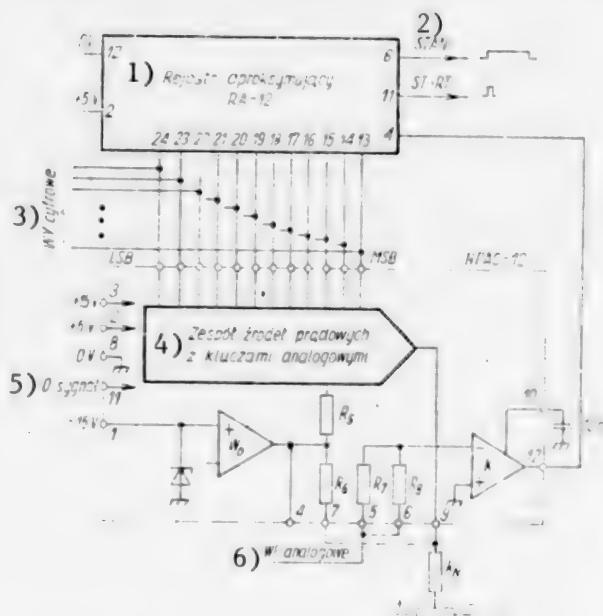


Figure 4. Block-diagram of A/D converter, type HPAC-12.

Key:

1. Approximation register, RA-12
2. State
3. Digital output
4. Set of current sources with analog keys
5. 0 signal
6. Analog input

DC/DC Converter with Galvanic Separator Type HPDC

This unit is intended for the construction of analog separators with the frequency transfer of analog value (u/f circuit, transoptor, f/u circuit) for the analog-digital separators when feeding from DC/DC converter coupled to input circuit with A/D converter (input, A/D converter, transoptor, digital circuit) and also for digital-analog separators when feeding from DC/DC converter of the output circuit with /A converter (digital circuit transoptor, D/A converter, output). Units with various output voltages and insulation strengths are to be manufactured. The basic parameters of these circuits are given in Table 4; the block diagram is given in Fig. 5. The system is based on the principle of energy conversion in a one-cycle outside induction circuit.

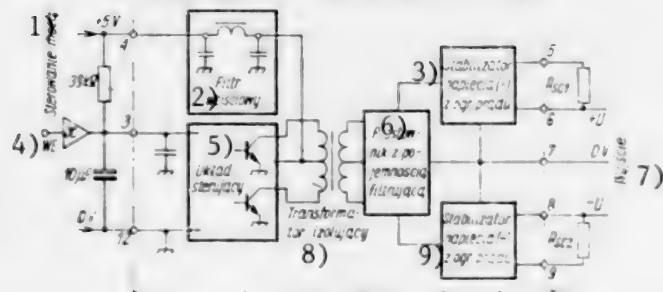


Figure 5. Block-diagram of DC/DC converter.

Key:

1. Power level control
2. Input filter
3. Voltage stabilizer (+)
4. Input
5. Control circuit
6. Rectifier with filtering capacity
7. Output
8. Isolation transformer
9. Voltage stabilizer (-)

Table 4. Basic Parameters of DC/DC Converters

<u>Parameter</u>	<u>HPDC-15</u>	<u>HPDC-12</u>	<u>HPDC-10</u>	<u>HPDC-15A</u>	<u>HPDC-12A</u>	<u>HPDC-10A</u>
Input voltage				5V ± 10%		
Output voltage, V	±15	±12	±10	±15	±12	±10
Output current, mA	±100	±120	±150	±100	±120	±150
Insulation strength to voltage		2 kV			6 kV	
Insulation impedance			15 pF 3000 MΩ			
Operation temperature, °C				0 - 70		

The use of resistors as sensors of current outside the frame allows setting the safety fuses at levels below I_{max} . The design of the rectifier and stabilizers allows nonsymmetrical setting of these components. A capability for controlling the output power level of the converter from the digital device with OC output is provided.

Functional Tester for LSI Circuits

Warsaw POMIARY AUTOMATYKA KONTROLA in Polish No 12, Dec 84 p 377

[Article by Andrezej Dziewa and Waclaw T. Kozlowski, engineers of Mera-Obreus, Electronic Research Center: "The Functional Tester of the LSI Circuits of the Intel 8080 Family"]

[Text] The device is intended for functional testing to verify whether an LSI circuit performs the required logical functions and operations. When standard loads are used at the inputs and outputs of a tested circuit and with a typical operation speed, the tester can also serve for acceptance quality control.

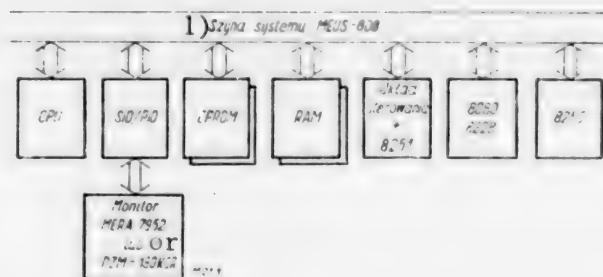


Figure 1. Block-diagram of functional tester of Intel LSI circuits.

Key:

1. Bus line of Meus-808 system

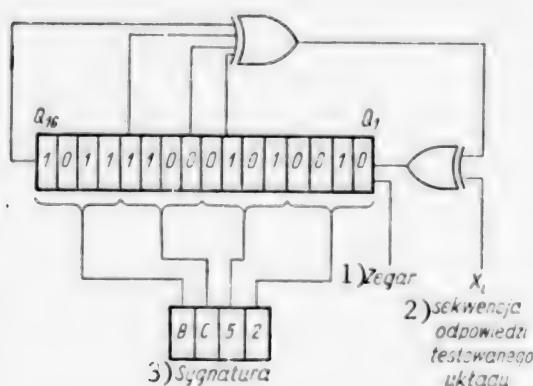


Figure 2. Principle of signature generation.

Key:

1. Clock
2. Response signal of the tested equipment
3. Signature

The Tester Design and Operation Principle

The device is based on a modular microprocessor system Meus-808 developed at Obreus Enterprises. In addition to the standard packages of Meus-808 systems (CPU, SIO/PIO, RAM, EPROM), the tester includes:

- the tester control package;
- specialized packages for testing the circuits 8080 + 8228, 8251, and 8255;
- a package for the testing the RAM 2102 memory (MCY 7102).

An extension of the configuration to include modules that would allow testing 8214, 8259, and 8253 circuits is envisioned. The set of specialized software packages can be expanded to use the device to test other circuits. The block diagram is shown in Fig. 1.

The testing is based on the method of signature analysis. This is one of the latest methods for functional testing developed by Hewlett-Packard.

The test is performed in two steps:

- a string of constraints of the circuit is generated and the response to the constraint string executed (the signature is generated);
- the resulting signature is matched against the standard signature.

The standard signatures have been generated when testing the original circuits manufactured by Intel. The signature is generated in a 16-bit moving serial-parallel register SIPO (Fig. 2).

An important function during signature generation is performed by the clock signal, which controls the entry and transmission of data in the signature register. The signal must be synchronized with the signal actuating the circuit being tested (the triggering string), as well as the current signal, which is a response to the trigger stimulus (the response string). The signal must be triggered in an exactly determined time and blocked after completion of signature generation. This requirement is crucial for signature stability.

Module of RAM Memory Testing

The module with the appropriate software allows the user to test the RAM memory before assembly or when eliminating an operational failure. The minimum area of memory to be tested is 1 kB. The memory is placed inside the module or the user package. From the large set of existing functional tests GALPAT 1 (galloping 1s and 0s) has been selected, which detects the improper operation of memory circuits (the relationship between access time and previous state of address inputs, splicings, and volatility).

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POLAND

MILITARY DESIGNS FOR RADAR RANGEFINDER FOR COAL MINES

Warsaw PRZEGLAD TECHNICZNY in Polish No 5, 3 Feb 85 p 15

[Article by Jerzy Chojnacki: "The Radar Gauge of Coal Level: Who Will Undertake the Manufacturing?"]

[Text] An instrument measuring the level of coal in accumulation collectors has recently become a popular item in coal mines. The earlier electric, mechanical and acoustic devices failed to meet the mining safety standards. The particularly difficult conditions in these collectors (the rising coal dust) during the unloading of coal made it difficult to ensure a failure-free operation of measurement devices in the pit.

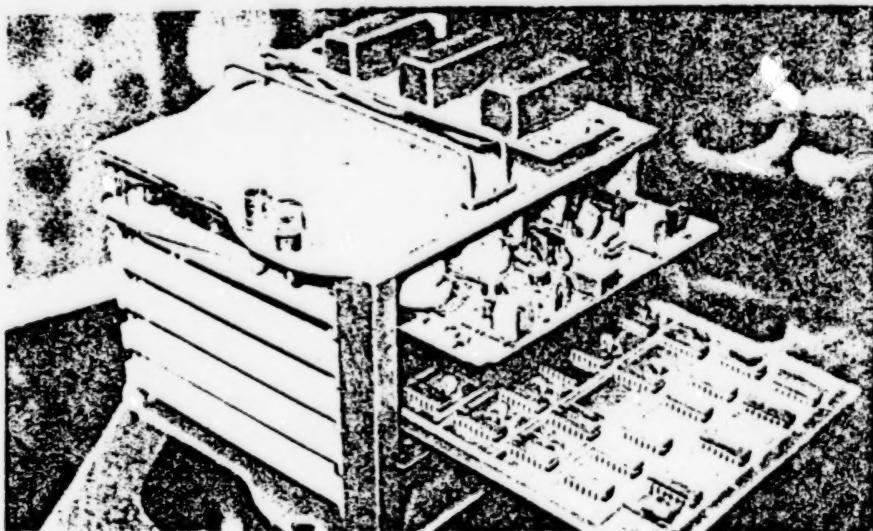


Figure 1. Coal level data processing and transmission unit.

When the level of coal in the collector drops below a certain critical height, the falling lumps of coal are shattered and damage the brick walls and the unloading structure. This may bring the collector on the pit bottom out of operation, leading to a reduction of coal output by as much as 90 percent. This is the amount that is brought to the day surface from the collector.

It is necessary to monitor continually the level of coal in the collector. The previous devices failed to provide this, and there was a need to develop new equipment meeting the mining safety standards. A request for the construction of such a device was submitted by two mines: Powstancow Slaskich and Sosnica. The development project was undertaken by a group of engineers from the Radiolocation Institute of the Military Technical Academy, headed by Colonel Dr. Stanislaw Janke, DSc (Eng). The other members of the group were Major Stanislaw Malinowski, DSc (Eng), Lieutenant Colonel Bernard Jurewicz, MS (Eng), Captain Andrzej Pieniezny, MS (Eng), and Marian Toloczko, MS (Eng).

The radar device for measuring the coal level is based on a method of radio-location for determination of distance. It consists of a microwave block and signal processing circuits. The circuits are housed in a standard mining equipment case. It is impermeable to gas and dust and is designed to prevent self-ignition of the unit. By measuring the time elapsed between the emission of a sounding signal and reception of the echo, the instrument determines the distance from the antenna to the reflecting surface of the coal.

The signal processing block transmits information about the coal level through a device of multiple two-state signal transmission. This information can be entered into the mining parameter control system through an appropriate input device. The indicators can be installed in the office of the mine supervisor, as well as in the cabin of the operator of control devices on the pit bottom. They receive information on the current level of coal in the collector, the critical level drop and the maximum filling. An additional communication line can be connected, leading, for example, to the apartment of the director of the mine.

"This instrument," explains one of the designers, Stanislaw Malinowski, "can also be installed in other rotational collectors and in collectors preparing mixes in processing plants."

The instrument developed by the staff of the Military Technical Academy has been tested under the conditions of a dynamic coal filling. Mining specialists have assessed it positively. They confirmed that it would be desirable to use this equipment in coal mining, especially since it is built of domestically available components. Yet, its authors are not fully satisfied. A large number of mines, including Sosnica, Powstancow Slaskich, Piast, Knurow, Boleslow Smialy and Janina, have placed orders with the Academy. However, the role of this educational institution should not go beyond the development of production blueprints for manufacturing, which must be done by an industrial organization. Time is running out, and it is almost certain that the Wilmer Factory of Microwave Equipment, which has confirmed its willingness to manufacture the instrument, will soon close its list of orders for 1985. The instrument is praised, but will it come to the mines? When will obstacles to its production disappear?

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